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LOWER MISSISSIPPI REGION COMPREHENSIVE STUDY. APPENDIX O. COAST--ETC(U)
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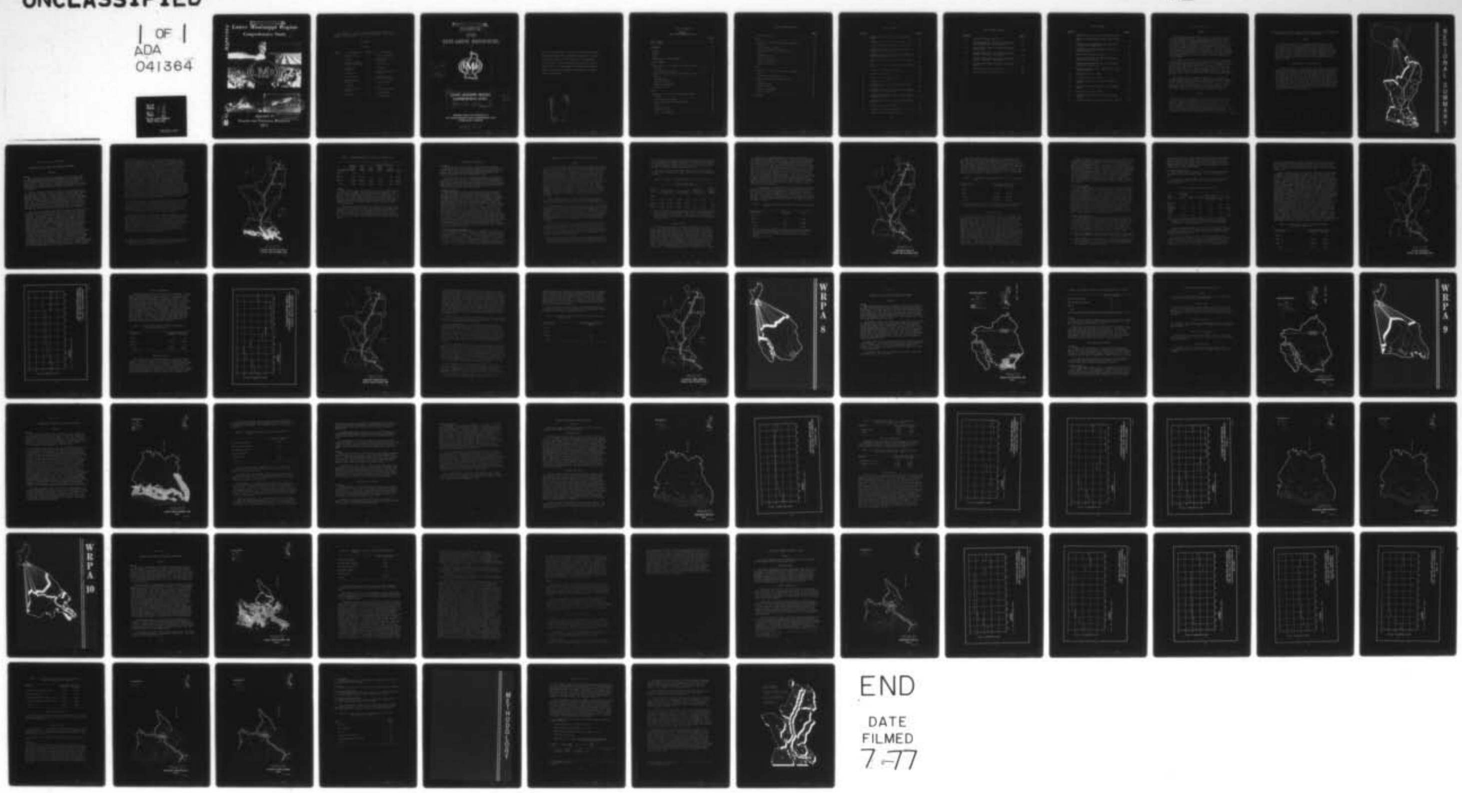

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Lower Mississippi Region

Comprehensive Study

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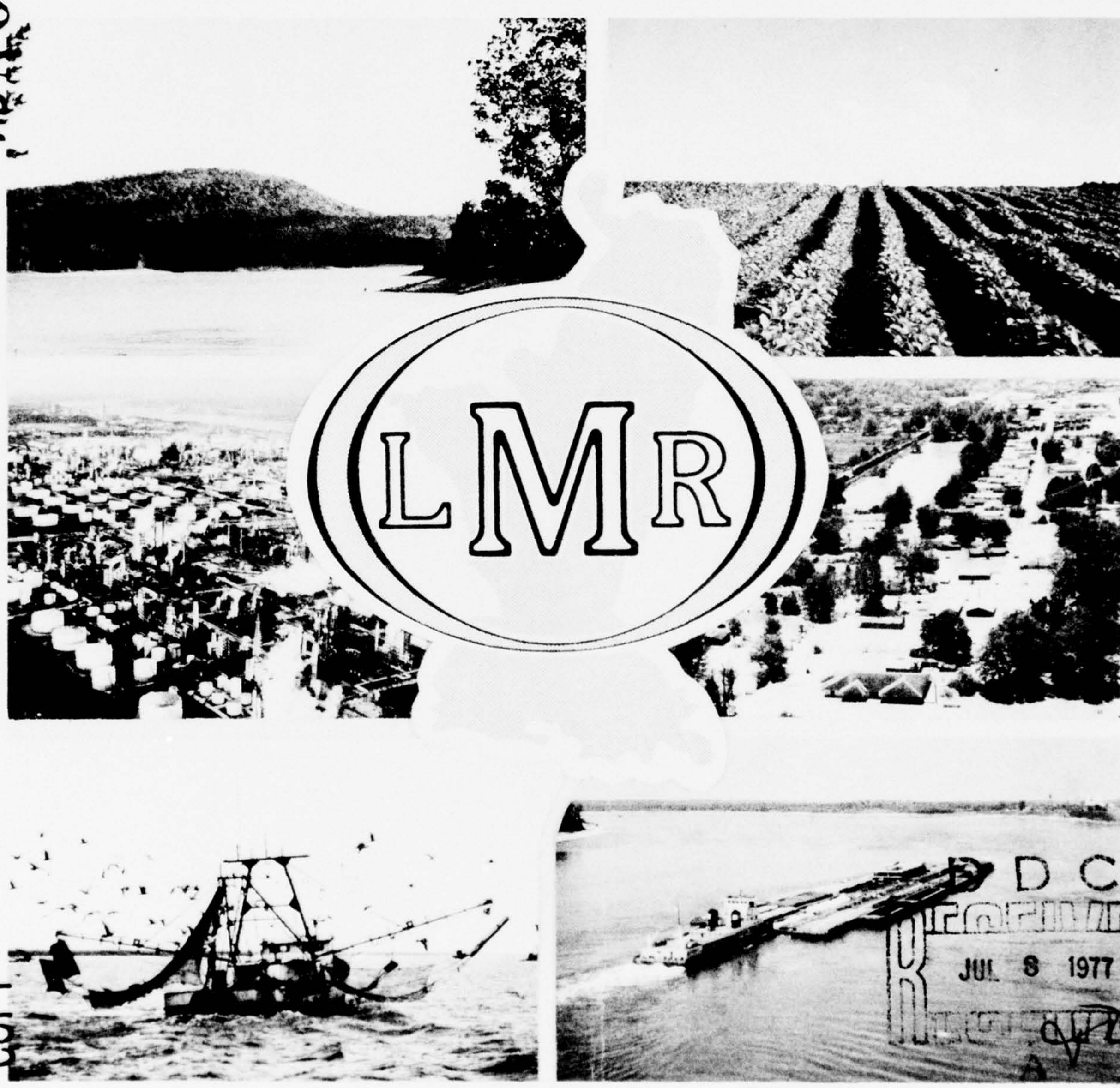

Appendix O

Coastal and Estuarine Resources

1974

This appendix is one of a series of 22 documents comprising the complete Lower Mississippi Region Comprehensive Study. A list of the documents is shown below.

Main Report

Appendixes

Appendix	Description	Appendix	Description
A	History of Study	K	M and I Water Supply
B	Economics	L	Water Quality and Pollution
C	Regional Climatology Hydrology & Geology	M	Health Aspects
D	Inventory of Facilities	N	Recreation
E	Flood Problems	O	Coastal and Estuarine Resources
F	Land Resources	P	Archeological and Historical Resources
G	Related Mineral Resources	Q	Fish and Wildlife
H	Irrigation	R	Power
I	Agricultural Land Drainage	S	Sediment and Erosion
J	Navigation	T	Plan Formulation
		U	The Environment

COASTAL AND ESTUARINE RESOURCES.

(11) 1974

(12) 75p.

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LOWER MISSISSIPPI REGION COMPREHENSIVE STUDY.

Appendix O.

PREPARED UNDER THE SUPERVISION OF
THE LOWER MISSISSIPPI REGION COMPREHENSIVE STUDY
COORDINATING COMMITTEE

This report was prepared at field level by the Lower Mississippi Region Comprehensive Study Coordinating Committee and is subject to review by interested Federal agencies at the departmental level, Governors of the affected States, and the Water Resources Council prior to its transmittal to the President of the United States for his review and ultimate transmittal to the Congress for its consideration.

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COASTAL AND ESTUARINE RESOURCES

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I N T R O D U C T I O N

GENERAL

The coastal and estuarine zone is an area of high productivity in the fish and wildlife resource. The unique environment which it provides has been developed and maintained through centuries of time by the massive volumes of sediment-laden fresh water transported by the Mississippi and its distributaries. The high productivity derives from its role as a complex biome where fresh and saline waters interact in a physical setting characterized by low land masses, shallow open-water areas, and prolific and highly varied vegetation. Its future viability in the fish and wildlife resource is dependent upon what might be called a dynamic near-equilibrium; i.e., a regimen of cyclical change in form and configuration which nevertheless leaves the essence of the zone itself unchanged.

The coastal and estuarine zone is currently marked by change which is noncyclic in nature. Deprived of its sedimentary input by perfection of flood control and navigation improvements, it is shrinking in size. Deprived of its fresh water input by the same works, and subject to myriad factors which tend to modify the tidal regimens, its water chemistry is being altered as average salinities in most areas rise. In the absence of measures specifically intended to moderate current patterns of change, estuarine productivity may be expected to progressively decline.

As the above suggests, among the important needs for maximizing estuarine productivity are inputs of sediment and fresh water. However, the only practicable means of introducing sediment in the massive quantities required is through diversion of riverflow. Hence, water must serve as the vehicle for transporting the sediment required. It is appropriate, therefore, that the needs of the estuarine zone, both as to sediment and fresh water, be expressed in terms of riverflow.

PURPOSE

The purpose of this appendix is to present the water-related needs for preserving and/or enhancing the coastal and estuarine zone with particular reference to productivity of fish and wildlife. The zone provides valuable habitat for the commercially important marine population dependent on the estuaries for a portion of their life cycle. The zone also provides one of the most important wintering areas in the Mississippi flyway for waterfowl and other migratory bird species. The maintenance of water quality and quantity in the wintering areas is

next page

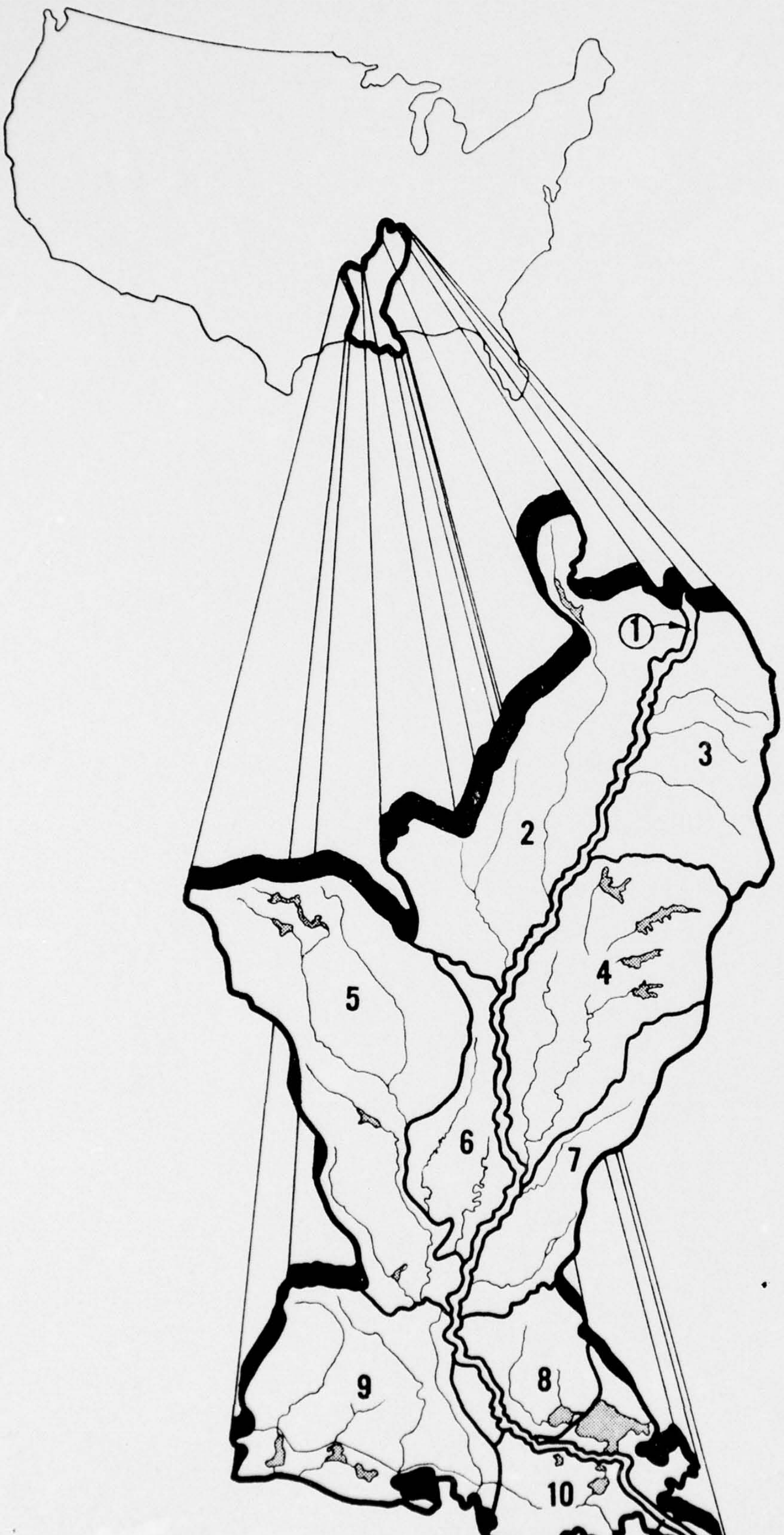
necessary to meet U. S. responsibility under provisions of the Migratory Bird Treaty Act of 1918 between the U. S. and Canada.

SCOPE

The needs presented in this appendix were developed under the limitations of data collected for the most part for other purposes. The complex problem of evaluating this estuary is accented by the limited knowledge of environmental factors affecting productivity and the manner of utilizing these factors to create optimum production of renewable resources. Furthermore, the science of ecology is in its infancy and, in its current state, does not permit formulations in the precise mathematical terms characteristic of engineering and other physical sciences.

RELATIONSHIP TO OTHER APPENDIXES

Background material for this appendix is presented in Appendix B, Economics, and Appendix C, Regional Climatology, Hydrology, and Geology. This appendix concentrates on problems and needs which are unique to the coastal and estuarine zone. Those relating directly to water supply, water quality, recreation, fish and wildlife, flood control, natural environment, and other resource needs are considered under those functional headings. Because the needs presented in this appendix are to preserve and enhance the zone, they must be used along with the needs in other categories, and in other areas, in comparing total Lower Mississippi Region needs with total Region resources. For information not covered herein on problems and needs in the coastal zone, the reader is directed to other functional appendixes.



REGIONAL SUMMARY

R E G I O N A L   S U M M A R Y

DESCRIPTION OF THE COASTAL AND ESTUARINE ENVIRONMENT

Physical

General

The coastal and estuarine zone comprises all of the area of the Lower Mississippi Region that would be inundated by the Standard Project Hurricane with all existing and authorized hurricane protection works in place. By definition, the coastal and estuarine zone is located totally within the State of Louisiana and includes only portions of the land area of Water Resources Planning Areas (WRPA's) 8, 9, and 10 (figure 1).

The zone consists of the lands and water areas bordering upon the Gulf of Mexico, including the many sounds, bays, lakes, rivers, bayous, and other bodies of water. The areas adjacent to the shoreline are generally composed of very low marsh, natural levees along existing and abandoned streams, chenieres, and isolated barrier islands. The predominant river is the Mississippi and, Lake Pontchartrain is the largest lake. The total land area in the zone approximates 4.6 million acres or 7 percent of the Lower Mississippi Region. While not a part of the zone, the offshore gulf out to the 100-fathom curve is, in effect, an integral part of the estuarine ecosystem, and must be so considered.

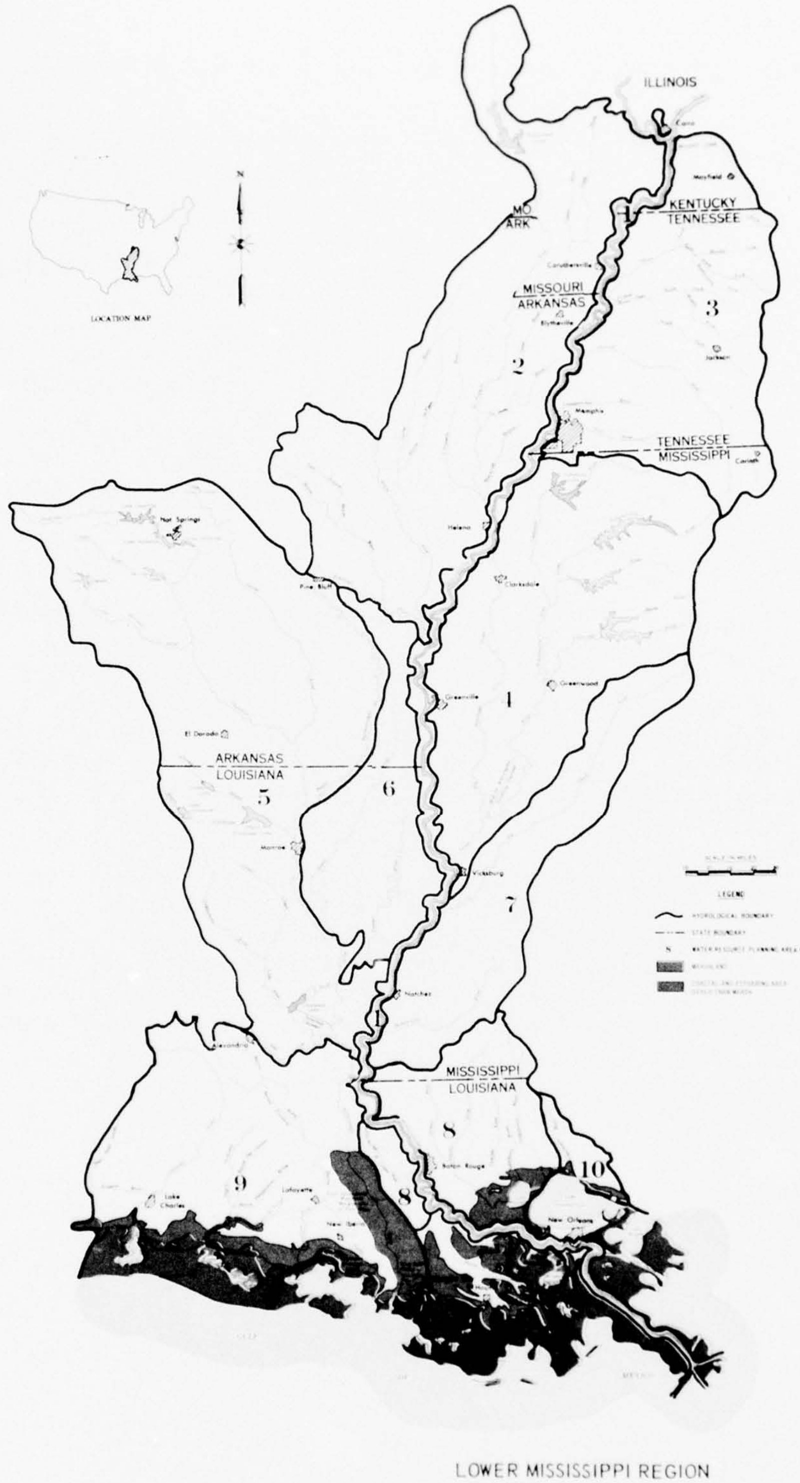
The coastal and estuarine zone has been formed by the deposition of sediments from the Mississippi River and its distributaries during the last 6,000 years, and by the action thereon of the waters of the Gulf of Mexico. Approximately 4,000 to 5,000 years ago, during the Sale-Cypremort stage, the Mississippi actively began to deposit large quantities of fine-grained sediment in the coastline of WRPA 9. Some of these sediments were transported westward by longshore currents and deposited beyond the limits of the delta proper as mudflats along the western coastline of WRPA 9. As the mudflats grew, marsh vegetation began to develop and the process of coastal buildup was initiated. About 4,000 years ago, the Mississippi River shifted from the Sale-Cypremort course and began building the Cocodrie delta by depositing its sediment within WRPA 10 in the vicinity of Lake Pontchartrain. With a shift in deltaic deposition from central to southeastern Louisiana, compaction and regional subsidence became the dominant processes along the western coast of Louisiana. Further, as a result of wave attack, beach deposits began to accumulate and the initial stage of cheniere development began. Approximately 3,500 to 3,800 years ago, the Mississippi River shifted its course westward to the Teche course. Granular material was once again deposited in vast quantities along the central Louisiana

shoreline, (WRPA's 9 and 10) and the delta began advancing seaward in the area of Terrebonne Parish. As during the Sale-Cypremort stage, westward prevailing longshore currents carried some materials toward the west and deposited them as mudflats along the shoreline of WRPA 9, creating stranded beaches or "chenieres", as they are termed locally. While general coastal buildup was occurring in central and western Louisiana during the Teche stage, general deterioration of the Cocodrie Deltaic mass was occurring in the northeastern part of WRPA 10, near Lake Pontchartrain. Approximately 2,800 years ago, the Mississippi River again shifted its course to occupy the St. Bernard course and began developing a vast delta in WRPA 10, extending from the general vicinity of Barataria Bay eastward into the gulf beyond the current position of the Chandeleur Island group. Approximately 1,200 years ago, the Mississippi River again shifted its course westward, causing the Lafourche delta to begin building and the shoreline, in the vicinity of Lafourche and Terrebonne Parishes, to advance seaward. Deterioration of the abandoned St. Bernard delta occurred concurrently with the buildup of the Lafourche delta. The Breton and Chandeleur Island groups represent a late stage in deltaic destruction resulting from subsidence behind the old shoreline and reworking of the ends of numerous old distributaries. Six hundred years ago the Mississippi River abandoned the Lafourche course in favor of its present course.

The natural marshes (figure 1) comprise about 51.65 percent of the land area in the coastal and estuarine zone. The marshes extend inland from the Gulf of Mexico for a distance between 20 and 35 miles. The natural marshes, as defined by Chabreck 1/, consist of land covered by marsh-type vegetation. These are low-lying areas, usually less than 3 feet in elevation above mean sea level, built with sediments deposited by the Mississippi River and/or by longshore currents.

Land-water interface relates to the length of shoreline. The land-water interface shown in table 1 comprises the tidal shoreline below the Gulf Intracoastal Waterway, 30,551 miles in length, which approximates the landward boundary of marshlands. In contrast, the gulf-shoreline has a length of only 801 miles. The length of interface is a significant factor in biological productivity. The Terrebonne-Barataria estuary located in WRPA 10, has an extensive land-water interface, broad shallow lakes and bays, extensive fringing swamps and marshes, and protective barrier islands. Because of these characteristics, it is associated with a high biological productivity.

1/ Chabreck, Robert H., "Vegetation, Water, and Soil Characteristics of the Louisiana Coastal Region", Bulletin No. 664, Louisiana State University Agricultural Experiment Station, 1972.



LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

REGIONAL MAP WITH OUTLINE OF COASTAL AND ESTUARINE ZONE

FIGURE 1

Table 1 - Land-Water Interface, Coastal and Estuarine Zone

Planning Area	Natural Stream Banks	Lake and Marsh	Canal Banks	Major River Banks	Gulf Shoreline	Total
	Miles of Interface					
WRPA 8	13	38	-	-	-	51
WRPA 9	1,154	2,157	773	75	126	4,285
WRPA 10	5,971	14,525	4,737	307	675	26,215
Total	7,138	16,720	5,510	382	801	30,551

Climate

The climate of the coastal and estuarine zone is characterized by mild winters, hot summers, and relatively heavy precipitation. The average annual temperature varies from 67.7° F. in WRPA 8 to 69° F. in WRPA 10. The average annual precipitation varies from 60 inches in WRPA 8 to 62.6 inches in WRPA 10. Major storms affecting this area are associated with hurricanes and extra-tropical cyclones. Convective thundershowers during the summer months produce intense but highly localized rainfall.

Hurricanes and lesser tropical storms generate tidal surges which raise tides far inland and result in the inundation of marshlands and lowlands. The hurricane storm tides and storm waves cause erosive attack upon the shoreline. The Standard Project Hurricane traveling on a critical track, would be accompanied by a hurricane surge of from 11 to 14 feet in elevation near the shoreline and to lesser elevations inshore.

Socioeconomic and Cultural

Population

The coastal and estuarine zone, as defined in this appendix, excludes metropolitan areas which have a high degree of protection from tidal floods by existing and authorized hurricane protection projects. However, New Orleans, Louisiana (SMSA population 1,045,809) is the largest metropolitan area lying adjacent to the zone.

The 1970 population of the coastal and estuarine zone was approximately 295,000 or 4.7 percent of the population of the Lower Mississippi Region. This population is projected to rise to 507,000 by 2020 under the National Income objective (5 percent of the Lower Mississippi Region) and to 574,300 by 2020 under the Regional Development objective (4.9 percent of the Lower Mississippi Region).

Economic Activities

The economy of the coastal and estuarine zone is based upon an abundance of natural mineral deposits, fish and wildlife resources, and some agriculture. Petroleum and natural gas fields are located throughout the land area and offshore in the Gulf of Mexico. Natural gas liquids, sulfur, salt, and gravel are other economically important minerals produced in the zone. The aggregate value of mineral production for the coastal and estuarine zone inclusive of offshore production amounted to over $4,070.7 million in 1970. The coastal marshes, bays, and the gulf comprise an extensive fishery for both the fresh water and euryhaline species. According to a report by the National Marine Fisheries Service, based on data for the period 1963 to 1967, the average annual value of fish and shellfish landed in the coastal and estuarine zone was approximately $60 million. The swamps and marshes of the coastal zone are responsible for Louisiana's leadership in the fur industry. As reported by the Commercial Wild Life Work Unit to the Fish and Wildlife Study of the Louisiana Coast and the Atchafalaya Basin, during the 1969-1970 season the state's meat and pelt production, led by nutria, muskrat, and raccoon, was valued at $6.9 million. Sugarcane, rice, and soybeans are the principal agricultural crops, amounting to over $61.0 million in 1969.

Cultural and Esthetic Resources.

Louisiana's coastal and estuarine zone contains many scenic, cultural, and esthetic resources. The area is noted for its history and renowned folklore. The history of Louisiana and that of the coastal and estuarine zone may be divided into five major time periods: (1) Indian, (2) French, (3) Spanish, (4) English, and (5) American. Each period has left a bountiful legacy of archeological and historical sites. For a listing of archeological and historical sites within the coastal and estuarine zone, see Appendix P, Archeological and Historical Resources.

SUMMARY OF COASTAL AND ESTUARINE PROBLEMS AND NEEDS

General

An ad hoc interagency group was established in 1969 by the Corps of Engineers to report on Mississippi River flow requirements for estuarine use in coastal Louisiana[2]. Investigations disclosed that continuing change is taking place in the coastal and estuarine zone in nearly all of the important physical and chemical parameters from which the zone derives its unique character. Further, it has become apparent that these changes relate, in the long-term sense, primarily to the alteration of the overflow regimen of the Mississippi River. In the past 250 years, man, through the construction of works to control devastating floods and to provide for dependable navigation, has increasingly restricted the overflow of the coastal and estuarine zone. Deprived of the overflow with its nourishing sediments, the area, through subsidence and erosion, is yielding to the sea a part of its essential substance - the alluvium deposited by repeated overflow over centuries of time. This loss of marshland area, combined with the loss of the freshening influence of overflow, is altering the basic character of the zone.

Another important source of change in the coastal and estuarine zone is the development of the area for various economic pursuits, particularly those associated with the fisheries and petroleum industries.

The overall value of the coastal and estuarine zone is difficult to assess with specificity. Economically speaking, mineral resources tend to dominate the zone, and the availability of these resources is largely unaffected by the changes taking place within it. Furthermore, the great monetary value of these nonrenewable resources tends to overshadow the renewable resources of the zone. Taken together, the foregoing factors tend to depreciate the value of any measures which might be responsive to the preservation of the estuarine zone as a source of renewable resources.

Present trends, however, are altering the view that the disparity in annual value of production of renewable resources, as opposed to a storehouse of nonrenewable resources, necessarily forecloses the case for estuarine preservation. Today the pressure to maintain productivity in the area of renewable resources is greatly increased, and the value o of such resources, as compared with those subject to depletion and inevitable exhaustion, is much enhanced.

2/ Ad Hoc Interagency Fish and Wildlife Study Group for the Louisiana Coast and the Atchafalaya Basin, "Report on Mississippi River Flow Requirements for Estuarine Use in Coastal Louisiana," November 1970.

This shifting emphasis compels more searching inquiry into the possibilities for extracting the mineral resources of the estuarine zone without seriously impairing its productive capacity, as well as the possibilities for enhancing estuarine productivity by seeking to control the myriad extrinsic and intrinsic factors which impact upon it.

The specific water resource development needs of the coastal and estuarine zone are summarized in table 2 and are discussed in subsequent paragraphs.

Table 2 - Summary of Estimated Needs, Coastal and Estuarine Zone

Planning Area	Water Related Needs: Land Building[1/] (c.f.s.)	(m.g.d.)	Salinity Control (c.f.s.)	(m.g.d.)	Water Level Management (c.f.s.)	(m.g.d.)	Shore protection Needs (Miles)
WRPA 8	0	0	0	0	0	0	0
WRPA 9	23,000	14,900	13,800	8,900	92,200	59,600	0
WRPA 10	522,000	337,300	43,300	28,000	0	0	10.1
Region Total	545,000	352,200	57,100	36,900	92,200	59,600	10.1

1/ The land building need for maintaining a dynamic near equilibrium in land loss-land gain in the entire coastal zone expressed in terms of Mississippi River flow are shown. The land building need for the entire zone prorated to WRPA's based on land loss in individual WRPA's are also shown.

Land-Water Ratio

The coastal and estuarine zone derives its unique value from its role as a discrete biome where the saline waters of the sea meet and mingle with fresh water inflows in a complex environment characterized by land areas at or near normal tidal level and water areas of shallow depth. Exceedingly productive in the fish and wildlife resource, estuarine zones derive their productivity from many factors. Other things being equal, however, the productivity of any estuarine zone will be in proportion to its size and configuration. The Louisiana estuarine area is one of the nation's largest and possesses a heavily indented shoreline - the most productive type insofar as fish and wildlife are concerned. As the attritive processes reduce the marshland area of the coastal zone, a corresponding reduction in its productivity will result.

The Center for Wetland Resources of Louisiana State University in Baton Rouge, under contract with the Corps of Engineers, has evaluated the changes in land-water ratio occurring in the coastal and estuarine zone during the past 30 years. The method employed by the Center involved detailed comparison of available planimetric maps of the coastal area. On this basis, the Louisiana coast was found to be deteriorating by the conversion of land areas to open water at the rate of 16.5 square miles per year. Of this amount, 0.1, 3.4, and 13.0 square miles per year loss are being experienced in WRPA's 8, 9, and 10, respectively. This loss, which results from the aggregate of attritive forces including erosion, subsidence, compaction, organic decay, and the various works of man, is detrimental to the maintenance of estuarine productivity. A graphic indicator of land loss is the 50 percent land-water isopleth. Without corrective action, the positions of this isopleth, for the years 1980, 2000, and 2020 are expected to be as shown on figure 2, which also shows the 1970 position.

It is reasonable to conclude that the total biological productivity of any given estuarine zone will likely be in proportion to its size. Thus, the land loss being experienced in the coastal and estuarine zone may be properly viewed as a potential loss in productivity. The needs must then be to maintain a dynamic near-equilibrium between land loss and land gain. The net needs for land building in the coastal and estuarine zone under both the National Income and Regional Development objectives are shown in table 3.

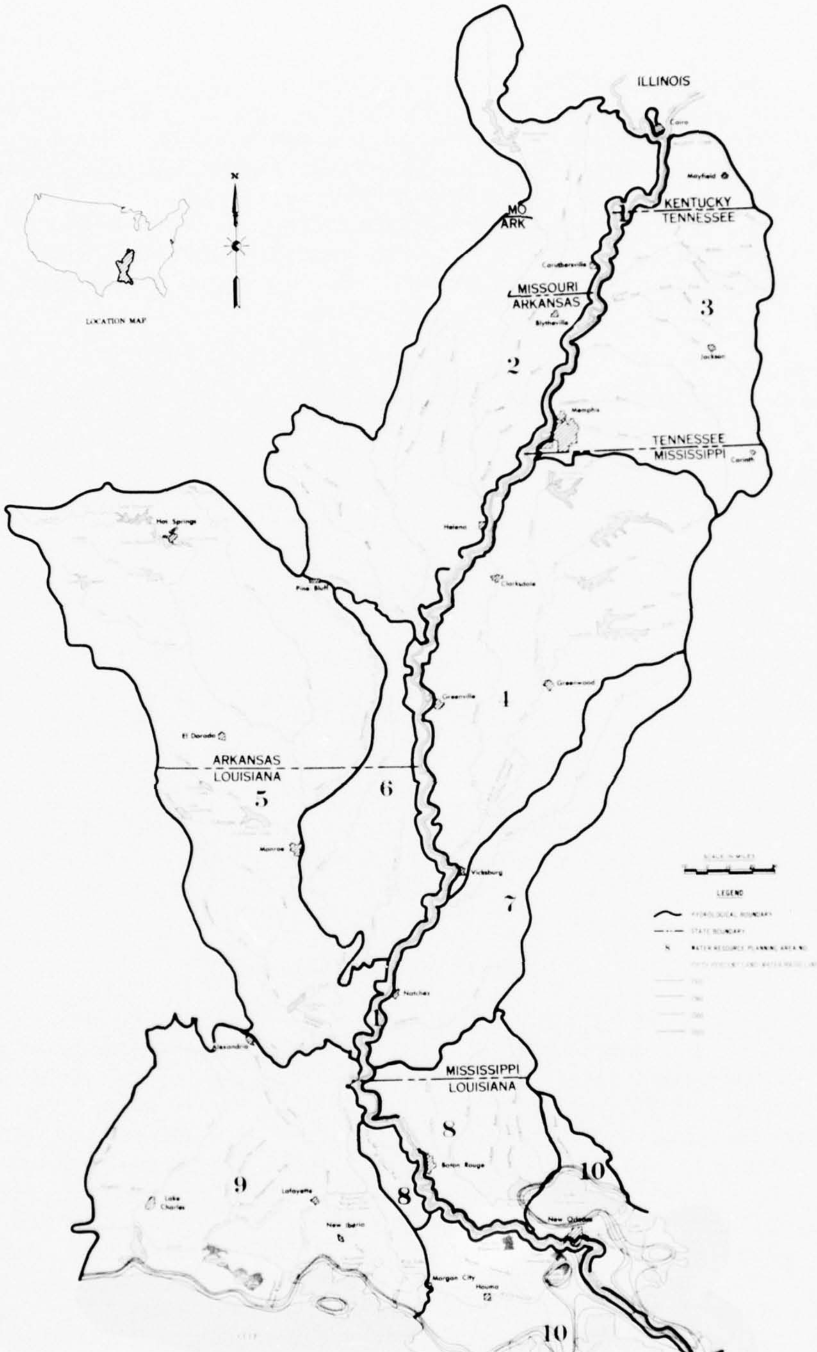
Table 3 - Estimated Net Land-Building Needs[1/], Coastal and Estuarine Zone

Planning Area	Sq.mi./yr.	Ac./yr.
WRPA 8[2/]	0	0
WRPA 9[3/]	1.7	1,100
WRPA 10	13.0	8,300
Total	14.7	9,400

1/ The net land building need for the entire zone prorated to WRPA's based on land loss occurring in individual WRPA's are shown.

2/ Not estimated because of minor extent of land loss occurring in WRPA 8.

3/ See para. 2 on p. 36.



LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

LAND-WATER ISOPLETH
COASTAL AND ESTUARINE ZONE

FIGURE 2

While the essential natural ingredient for building new land is not water but sediment, the water represents the essential vehicle which must serve to deliver the needed sediments to the areas in which new marshland is to be generated. Since the relationships between riverflow and sediment transport are reasonably well known, it is appropriate to express coastal and estuarine land-building needs in terms of the flow of the Mississippi River below its junction with Old River, some 80 miles above Baton Rouge. The net needs, in terms of average annual Mississippi River flows, are shown in table 4.

Table 4 - Estimated Net Land-Building Needs[1/], Coastal and Estuarine Zone

Planning Area	Mississippi River Flow	
	(c.f.s.)	(m.g.d.)
WRPA 8	0	0
WRPA 9	23,000	14,900
WRPA 10	522,000	337,300
Total	545,000	352,200

1/ The net land building need for the entire zone prorated to WRPA's based on land loss occurring in individual WRPA's are shown.

Salinity Alteration

In the past, water salinities in the coastal and estuarine zone were generally characterized by relative stability, particularly with respect to the transition from fresh to saline zones, and by gradual salinity change during and after floods. This was due in large measure to the length of the flood season and the network of natural drainage channels which served to buffer the effects of both the tidal influx of saline water and the input of fresh water runoff. This tempering of the effects of floods and tides, and the prolonged flood season, served to maintain areas of low salinities that were much larger than such areas are today. Levee construction, with the resulting discharge of most of the flow of the Mississippi River directly into deep water in the Gulf of Mexico, has greatly diminished the quantity of fresh water entering the marshes. The extensive channelization of the marshes for navigation and drainage has increased the rates of fresh water runoff - tidal exchange, and provided avenues for the intrusion of salt water. The foregoing developments have resulted in a long-term trend toward increased salinities in certain areas of the marshes.

Perhaps the best indicator of long-term changes in salinity is the development of patterns of vegetative types which, in general, can be closely correlated with salinities. As a basis for the discussion of changes in marsh vegetation, the coastal area has been classified by marsh zones and vegetative types. The marsh zone was further subdivided into Cheniere Plain Marsh, Inactive Delta Marsh, and Active Delta Marsh. The vegetative types were grouped according to their relative tolerance to salt, and the marsh classified as fresh, intermediate, brackish, or saline on the basis of the plants present. Changes in the location of the saline and brackish marsh zones were determined by comparing a vegetative type map made on the basis of studies in the period from 1941 to 1945 3/ with a map showing vegetative types in 1968 4/ - an interval of about 25 years. Discussion of the findings for the various zones follows:

Cheniere Plain Marsh

No noticeable change has occurred in the saline marsh which occupies a narrow strip about 0.5 mile wide adjacent to the Gulf of Mexico. The northern boundary of the brackish marsh, which formerly extended inland a mean distance of 5.6 miles, now extends only 3.2 miles inland. Since the saline vegetative type has maintained essentially the same position over the years, the seaward movement of brackish marsh represents a reduction in the width of this type of about 50 percent. The reduction in width of the brackish type marsh reflects a reduction in water salinities in that area. Factors contributing to the reduction of salinities in the southwestern Louisiana coastal area include the construction of Wax Lake Outlet which resulted in the diversion of Atchafalaya River water into Vermilion Bay, the development of Mermentau Basin as a fresh water reservoir for rice irrigation, and the development of projects in the Rockefeller and Sabine Refuges which serve as partial barrier to salt-water intrusion.

Inactive Delta Marsh Zone

In contrast to the stability in the saline zone in the Cheniere Plain Marsh during the 25-year period, map measurements indicate that the saline zone within the Inactive Delta Marsh moved inland an average of 2.1 miles, from an average width of 5.8 miles on the earlier map to an average of 7.9 miles on the 1968 map. The earlier map shows brackish marshes extending inland for an average of 12.4 miles, and in 1968, for an average of 16.2 miles. While a reduction in the brackish type marsh took place in the Cheniere Plain, this type marsh

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3/ O'Neil, "The Muskrat in the Louisiana Coastal Marshes," Louisiana Department of Wild Life and Fisheries, New Orleans, Louisiana, 1949.

4/ Chabreck, Robert H., Ted Joanen, A. W. Palmisano, "Vegetative Type Map of the Louisiana Coastal Marshes," Louisiana Cooperative Wildlife Research Unit, Louisiana Wild Life and Fisheries Commission, and Louisiana State University, 1968.

actually widened in the Inactive Delta Marsh during the 25-year period. On the earlier map, the average width of brackish marsh was 6.6 miles, and on the 1968 map, 8.3 miles. Increases in the area of saline and brackish marshes are attributed to increased canal dredging and stream channelization in the area which have facilitated intrusion of highly saline waters from the Gulf of Mexico.

Active Delta Marsh Zone

This zone now consists primarily of fresh and intermediate marsh. No attempt was made to determine changes in the saline and brackish areas.

A breakdown of natural marshes (land areas in the region covered by marsh-type vegetation) by marsh zones and vegetative types, is given in table 5.

Table 5 - Marsh Zones and Vegetative Types

Marsh zones	Percentage of total marsh	Saline	Brackish	Vegetative Types 1/ Intermediate	Fresh	Total
				(thousands of acres)		
Cheniere Plain	36.3	29	279	249	306	863
Inactive (subdelta)	58.7	441	450	83	420	1,394
Active Delta	5.0	0	25	53	41	119
Total	100.0	470	754	385	767	2,376

1/ Average water salinities for vegetative types are as follows: Saline, 18 parts per thousand; Brackish, 8 parts per thousand; Intermediate, 3 parts per thousand; Fresh, 1 part per thousand.

Fresh and brackish marshes are seen to be nearly equal in size, constituting 32.3 and 31.7 percent, respectively, of the natural marsh. Saline marsh comprises 19.8 percent of the total area, and the intermediate marsh, 16.2 percent.

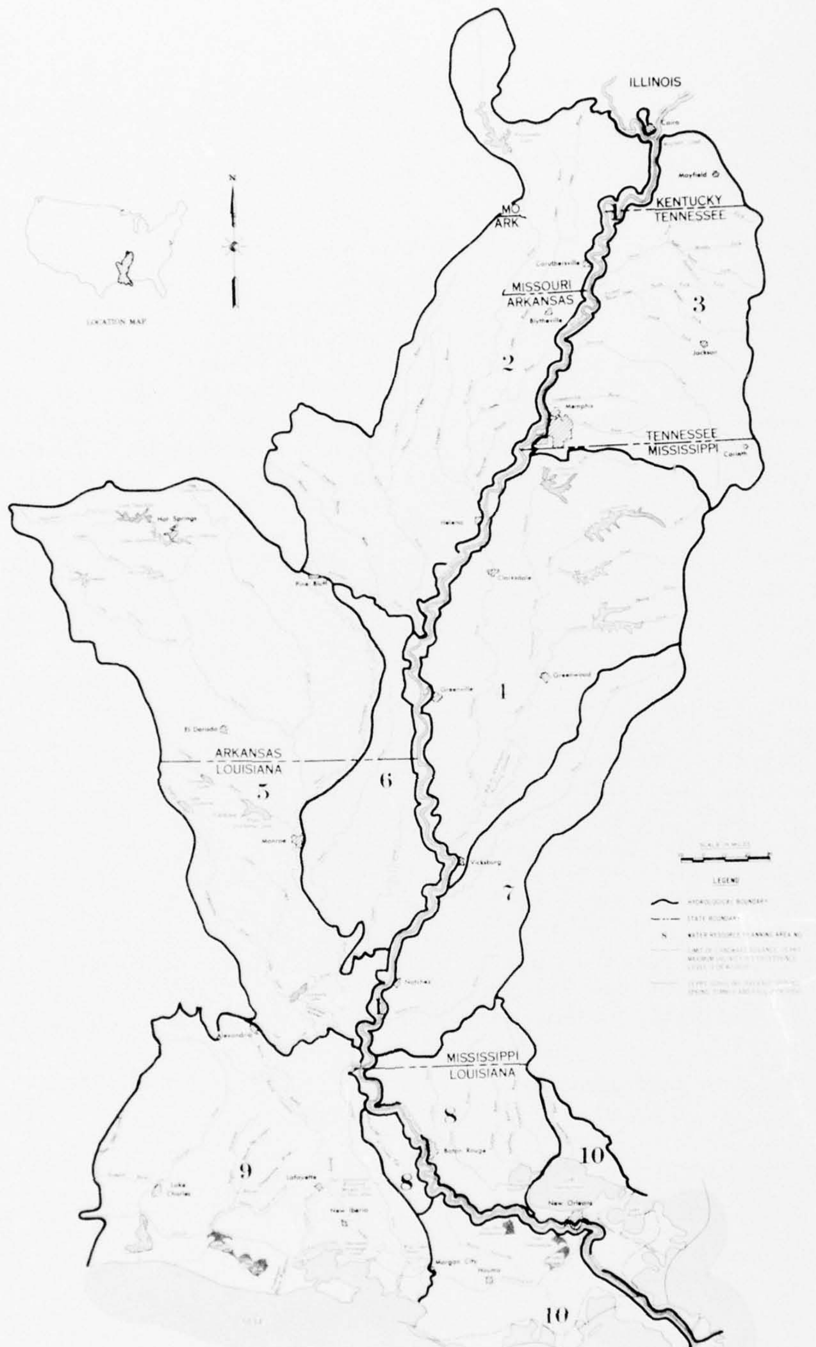
The fishery productivity of the coastal and estuarine zone is directly related to salinities, which are too high in the Lake Pontchartrain - Lake Borgne area, Breton Sound area, Caminada - Barataria - Bastian Bay area, Caillou - Terrebonne - Timbalier Bay area, and in the Calcasieu Lake Area. Optimum conditions can be achieved in these

areas by the maintenance during spring, summer and fall of the 15 parts per thousand (p.p.t.) mean salinity isohaline at the general location shown on figure 3. Minor fluctuations due to wind or tide are tolerable. This regimen is required to maximize commercial and sport fishery productivity.

Recent salinity increases, in the areas described in the preceding paragraph, have caused changes in vegetative types that are unfavorable to wildife. The brackish-saline marsh contact has been designated as a critical line for defining salinity requirements of the marsh communities. A comparison of marsh vegetation in the period 1941-45 and 1968 indicates that this brackish-saline contact line has shifted significantly in a number of areas during the past 25 years. Most shifts indicate saltwater encroachment and have been deemed detrimental. A seaward shift of this contact line is considered favorable to reestablish the 1941-45 position of the line in those instances where saltwater encroachment has occurred, and to maintain the present position of the contact in those areas where it has moved seaward. In order to achieve those results, it has been recommended that the seawardmost position of the saline-brackish marsh contact, a combined line constructed from 1949 and 1968 marsh-vegetation maps (as shown on fig. 3), be used to define desirable salinity conditions from the standpoint of marsh ecology. The requirement states that salinities are not to exceed 15 p.p.t. salinity at this line, more often than 5 percent of the time. If the condition established in the paragraph above is met, the condition set forth herein will be met also in spring, summer, and fall. This requirement dictates water needs throughout the year in the Calcasieu Lake area, and establishes the index for water needs during the fall and winter (Oct-Mar) in the Lake Pontchartrain - Borgne area, Breton Sound area, Caminada - Barataria - Bastian Bay area and Caillou - Terrebonne - Timbalier Bay area. Figure 4 shows the estimated needs to meet both requirements in terms of Mississippi River flow below Old River. Table 6 shows the average annual needs, which are the same for the years 1970, 1980, 2000, and 2020 under both the National Income and Regional Development objectives.

Table 6 - Estimated Water Needs for Salinity Alteration, Coastal and Estuarine Zone

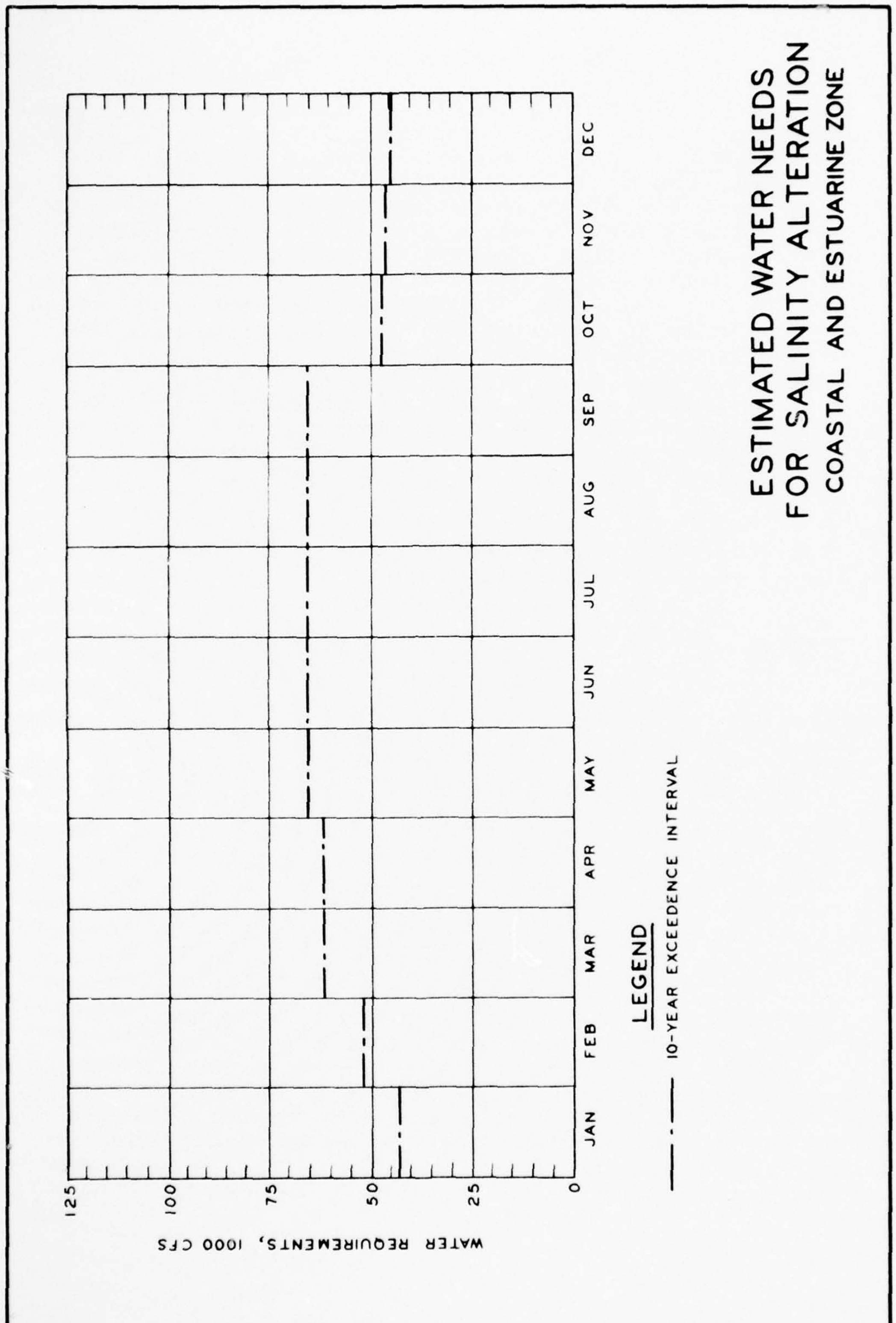
Planning Area	Mississippi River Flow	
	(c.f.s.)	(m.g.d.)
WRPA 8	0	0
WRPA 9	13,800	8,900
WRPA 10	43,300	28,000
Total	57,100	36,900



LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

CRITICAL SALINITIES
COASTAL AND ESTUARINE ZONE

FIGURE 3



ESTIMATED WATER NEEDS FOR SALINITY ALTERATION
COASTAL AND ESTUARINE ZONE

FIGURE 4

Water Level Management

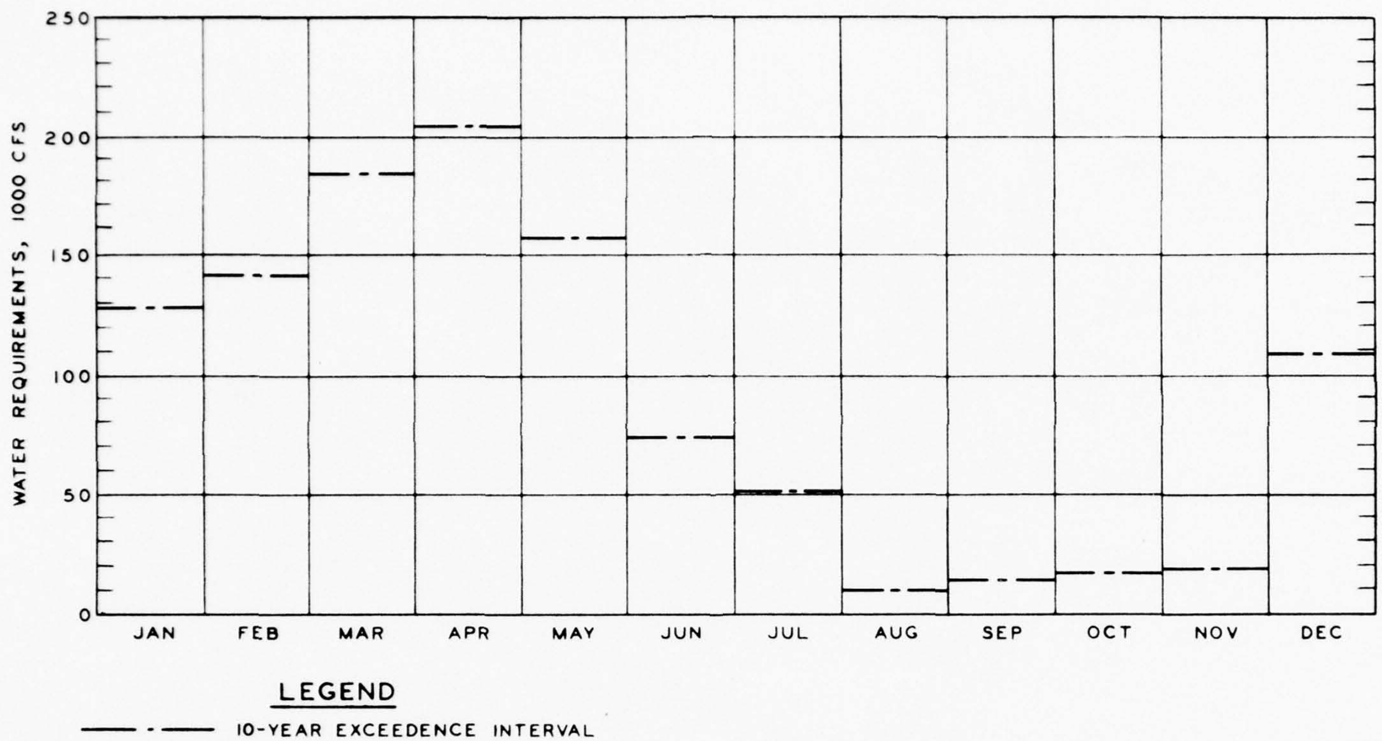
Estuarine productivity in the coastal zone is dependent, in large measure, upon the pattern of cyclical change in water levels. Supplemental water beyond that available from runoff is required in the Grand-White Lake area to maintain a minimum water level of 2 inches above the marsh floor for the period August through May. Satisfaction of this requirement would promote maximum growth of desirable plants which would enhance wildlife productivity. Additionally, in the Atchafalaya Floodway area, supplemental water is required to optimize fish and wildlife production. The requirement is equal to the optimum flow (as determined by the Ad Hoc Interagency Group conducting the Fish and Wildlife Study of Coastal Louisiana) minus the average minimum flow normally available. Figure 5 shows the supplemental water needs for water level management in terms of Mississippi River flow below Old River. Table 7 shows the average annual needs, which are the same for the years 1970, 1980, 2000, and 2020 both under the National Income and Regional Development objectives.

Table 7 - Estimated Water Needs for Water-Level Management, Coastal and Estuarine Zone

Planning Area	Mississippi River Flow (c.f.s.)	Mississippi River Flow (m.g.d.)
WRPA 8	0	0
WRPA 9	92,200	59,600
WRPA 10	0	0
Total	92,000	59,600

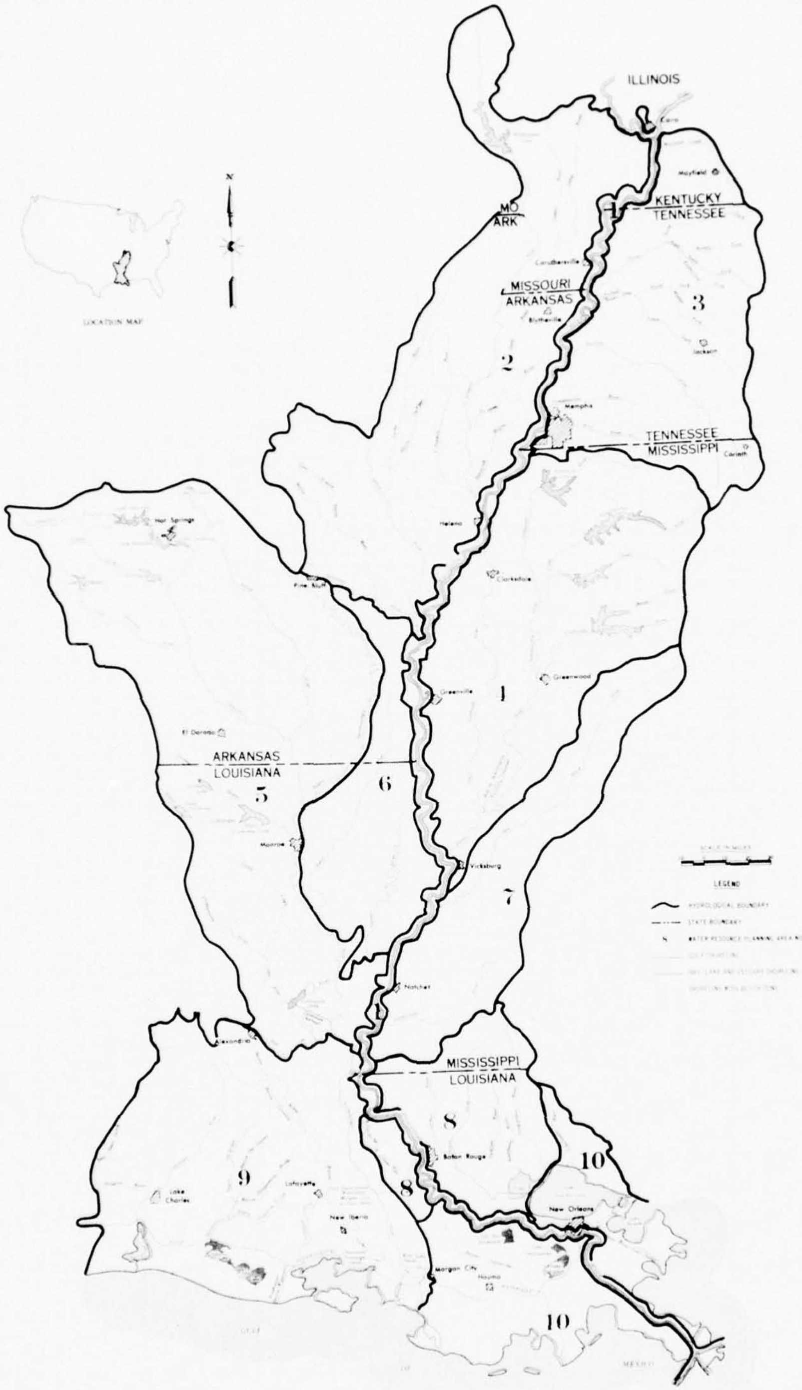
Shoreline Erosion

The shoreline of the coastal and estuarine zone consists almost entirely of low-lying marshes fronted either by sand beaches, shell beaches, or mud flats (figure 6). For many years after the Mississippi River occupied its present location, floodwaters and sediments were widely dispersed in the marsh and coastal area by overbank flow and through many distributary channels such as the Atchafalaya River, Bayou Lafourche, Bayou Barataria, Bayou Terre aux Boeufs, and Bayou La Loutre. The distributary channels, except for those of the Atchafalaya and



ESTIMATED WATER NEEDS
FOR WATER LEVEL MANAGEMENT
COASTAL AND ESTUARINE ZONE

FIGURE 5



LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

SHORELINE CHARACTERISTICS
COASTAL AND ESTUARINE ZONE

FIGURE 6

Mississippi Rivers, have been closed by natural processes and flood control improvements. The overbank flood flows of the Mississippi and Atchafalaya Rivers have been confined by levee construction. The only points along the Louisiana shoreline now receiving appreciable sediments from the inland areas are the present Mississippi River Delta and the Atchafalaya Bay area. The amount of sediments received at these points varies with river stages. Normally there is a slow rise in river stages beginning about December to a flood peak and a gradual fall until July or August followed by a low-flow period extending to December. Peak stage,duration, and the annual flood discharge vary greatly from year to year. The amount of sediments carried to the coastal area varies generally with the volume of flood flow and most of the sediments from the Mississippi River are deposited in deep water along the edge of the continental shelf.

Erosion now taking place along the shoreline is the result of normal wind waves, tidal action, and storm waves. The amount of erosion and/or accretion varies greatly along the shoreline.

The coastal marsh has a very high content of organic material resulting from decayed vegetation. In most areas the aggradation from additional vegetation and sediments is not sufficient to offset consolidation of previously deposited materials and subsidence takes place. The average subsidence in the Louisiana coastal marsh is estimated at about 0.4 foot per century. Due to the very low elevation of the marsh (sea level to 1 or 2 feet), any subsidence increases its vulnerability to wave attack. Any loss of barrier islands now extending along part of the zone will increase the exposure of the inland marsh to wave attack.

Except for the Mississippi River Delta area, practically all of the shoreline is in retreat. The locations at which the shoreline is stable (about 19 miles) or accreting (about 340 miles) are shown on figure 7. The areas in which buildup is taking place are east of Sabine Pass, east of Calcasieu Pass in the vicinity of Freshwater Bayou, the eastern end of Grand Isle, and a part of the Mississippi River Delta shoreline. The seawall along a part of the New Orleans lakefront and at Mandeville, and levee wave-wash protection along the Jefferson Parish lakefront, have stabilized the shoreline in those areas. Areas of maximum erosion are the gulf coastline of Isle Dernieres and Timbalier Islands.

In the National Shoreline Study,[5/] areas undergoing significant erosion were categorized critical if the rate of erosion, considered in conjunction with economic, industrial, recreational, agricultural, navigational, population trend, ecological, and other relevant factors, indicated that action to halt erosion may be or become justified. Areas

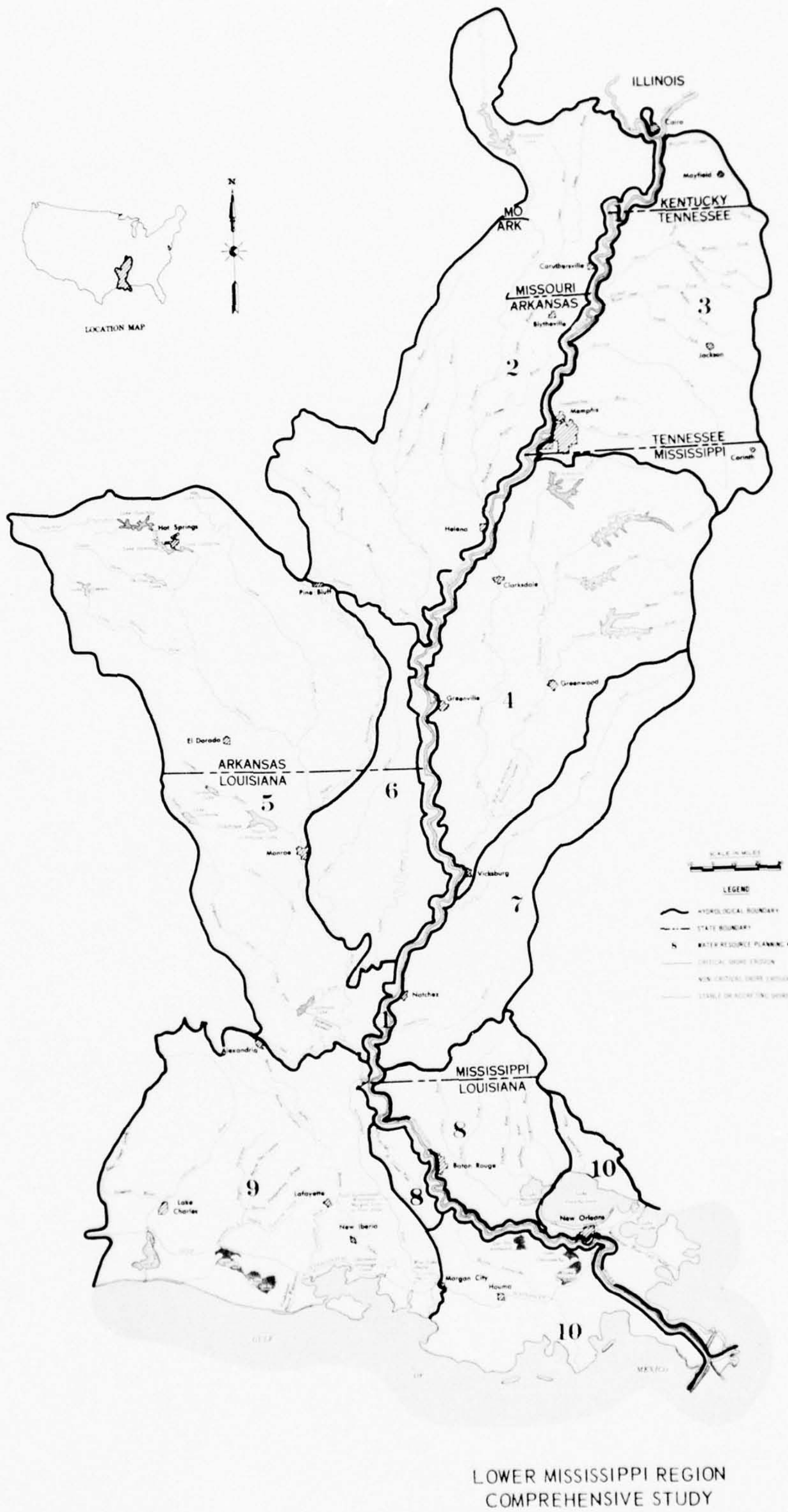
5/ "National Shoreline Study, Inventory Report - Lower Mississippi Region," U.S. Army Corps of Engineers, July 1971.

undergoing significant erosion were categorized noncritical if consideration of these factors indicated that management to prevent or minimize adverse effects may be more appropriate than action to halt erosion. Areas of critical shore erosion, noncritical shore erosion, and non-eroding shore are shown on figure 7. Locations of critical erosion, as defined above, are at Grand Isle, Fort Livingston, Fort Pike, Illinois Central Railroad traversing the St. John the Baptist Parish shoreline, and Fontainebleau State Park Beach.

Table 8 shows the estimated coastal and estuarine zone needs for shoreline erosion control. Estimated needs are the same under both the National Income and Regional Development objectives.

Table 8 - Estimated Shoreline Erosion Control Needs, Coastal and Estuarine Zone

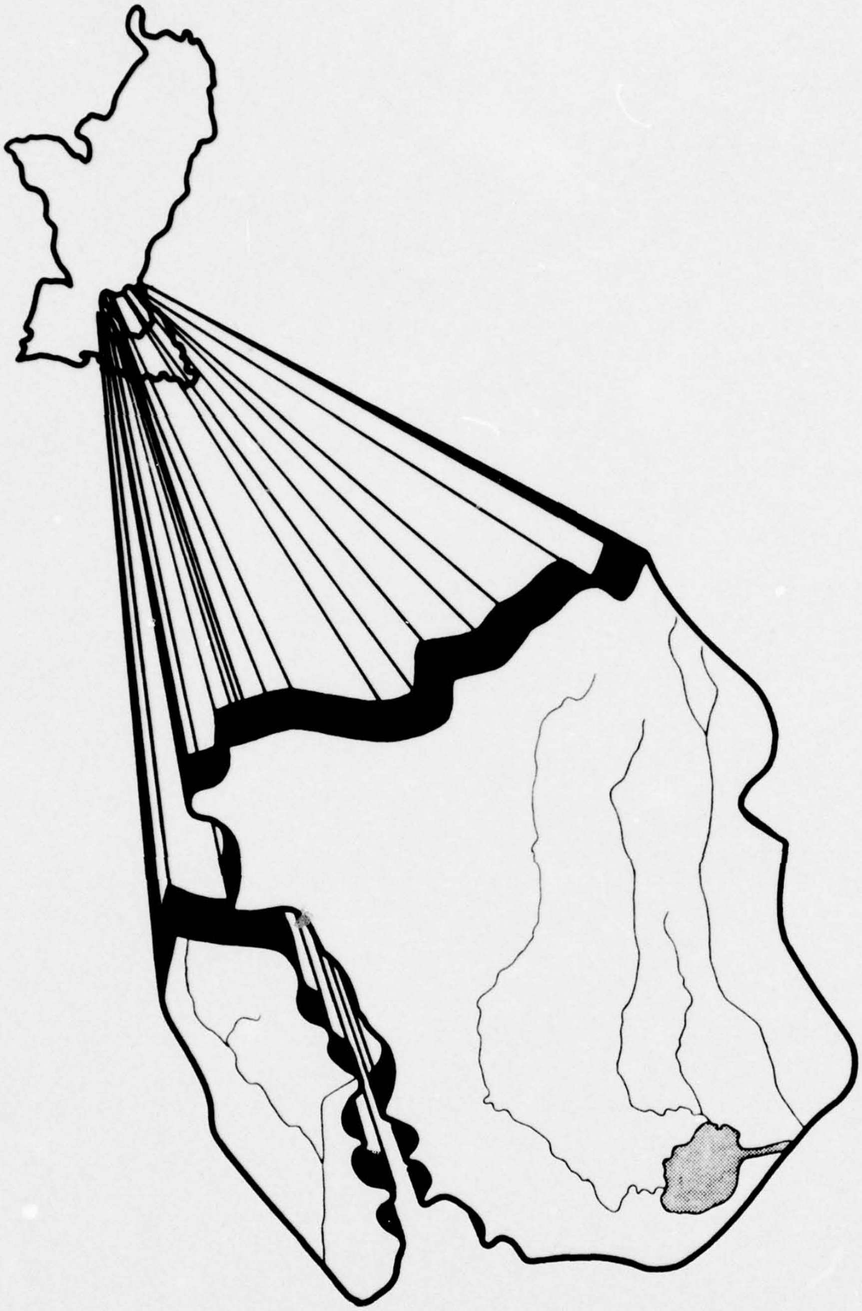
Planning Area	Critical Shore Erosion (Miles)
WRPA 8	0
WRPA 9	0
WRPA 10	10.1
Total	10.1



LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

HISTORICAL SHORE CHANGES
COASTAL AND ESTUARINE ZONE

FIGURE 7



WRPA 8

W R P A 8

DESCRIPTION OF COASTAL AND ESTUARINE ENVIRONMENT

Physical

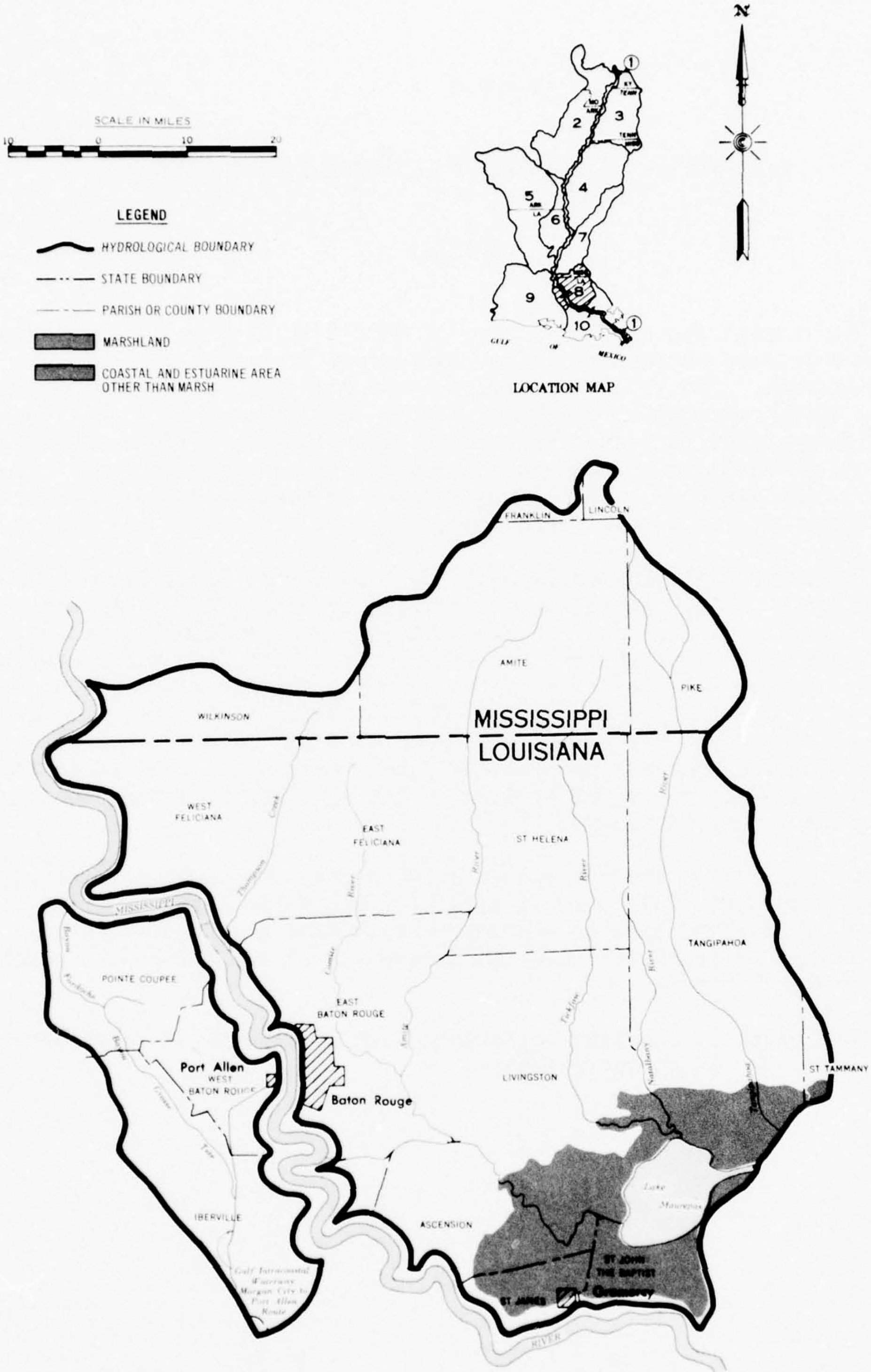
General

The coastal and estuarine zone of WRPA 8 is that small portion of the WRPA located northeast of the Mississippi River and west of Lake Pontchartrain. The total land area in the zone comprises some 300,000 acres, which cover about 8 percent of the land area of WRPA 8 (figure 8). Located from east to west, the major streams flowing through the zone are Tangipahoa River, Natalbany-Ponchatoula-Tickfaw Rivers, and Amite River. Lake Maurepas, with a surface area of some 58,000 acres, is the only large body of water in the zone.

Approximately 4,000 years ago, the Mississippi River began building the Cocodrie delta, causing the deposition of sediments within the coastal and estuarine zone. Approximately 3,500 to 3,800 years ago, the Mississippi River shifted its course westward to the Teche course, causing general deterioration of the Cocodrie deltaic mass, ending the natural deposition of sediments in WRPA 8. Since that time, the Mississippi River has changed its course three times; namely, eastward to the St. Bernard course approximately 2,800 years ago, westward to the Lafourche course approximately 1,200 years ago, and to its present course about 600 years ago.

Saline marshes are not encountered in this zone, which is primarily wooded swampland. Only a small area of fresh-water marsh covering 1.7 percent of the land area in the zone within WRPA 8 (approximately 5,000 acres) is found at the southeastern tip of the WRPA, just north of Lake Pontchartrain.

The length of the land-water interface is 51 miles. This land-water interface is shown in table 9.



LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

COASTAL AND ESTUARINE ZONE

WRPA 8

FIGURE 8

Table 9 - Land-Water Interface, Coastal and Estuarine Zone - WRPA 8

	Miles of Interface
Natural Stream Banks	13
Lake and Marsh Shoreline	38
Other1/	0
Total	51

1/ Excavated Canal Banks, Major River Banks and Gulf Shoreline

Climate

The climate of WRPA 8 is characterized by mild winters, hot summers, and relatively heavy precipitation. The average temperature is 67.7° F., and the average precipitation is 60 inches.

Hurricanes and lesser tropical storms generate tidal surges which raise tides above the elevation of the shoreline of Lake Maurepas resulting in the inundation of the low-lying swamp lands. The high storm tides and storm-swept waves subject the shoreline to erosive attack. The Standard Project Hurricane, traveling on a critical track, would be accompanied by a hurricane surge varying from 11 to nearly 14 feet in elevation near the shoreline and to lesser elevations inshore.

Socioeconomic and Cultural

Population

In 1970 about 16,000 people, or 3 percent of the population of WRPA 8 lived in the coastal zone. From 1940 to 1960 the population of the zone increased 13 percent, while the population of WRPA 8 increased 58 percent. From 1960 to 1970, however, the population of the zone increased 24 percent, while the population of WRPA 8 increased 17 percent.

The population of the coastal and estuarine zone is projected to rise to 30,000 by 2020 under the National Income objective and to 34,000 by 2020 under the Regional Development objective.

Economic Activity

The coastal zone includes corners of Tangipahoa, Livingston, Ascension, St. James, and St. John the Baptist Parishes, which are adjacent to Lake Pontchartrain or Lake Maurepas. Economic activities in this area include the production of some natural gas and petroleum, commercial fisheries, and some agricultural production, primarily sugarcane.

COASTAL AND ESTUARINE PROBLEMS AND NEEDS

General

Specific water resources development needs for the coastal and estuarine zone of WRPA 8 are discussed below.

Land-Water Ratio

The coastal and estuarine zone of WRPA 8 has been experiencing land loss at an average rate of 0.1 square mile per year. A graphic indication of land loss is the 50 percent land-water isopleth (figure 9). The land loss is minor in extent and no needs for its reduction are estimated.

Salinity Alteration

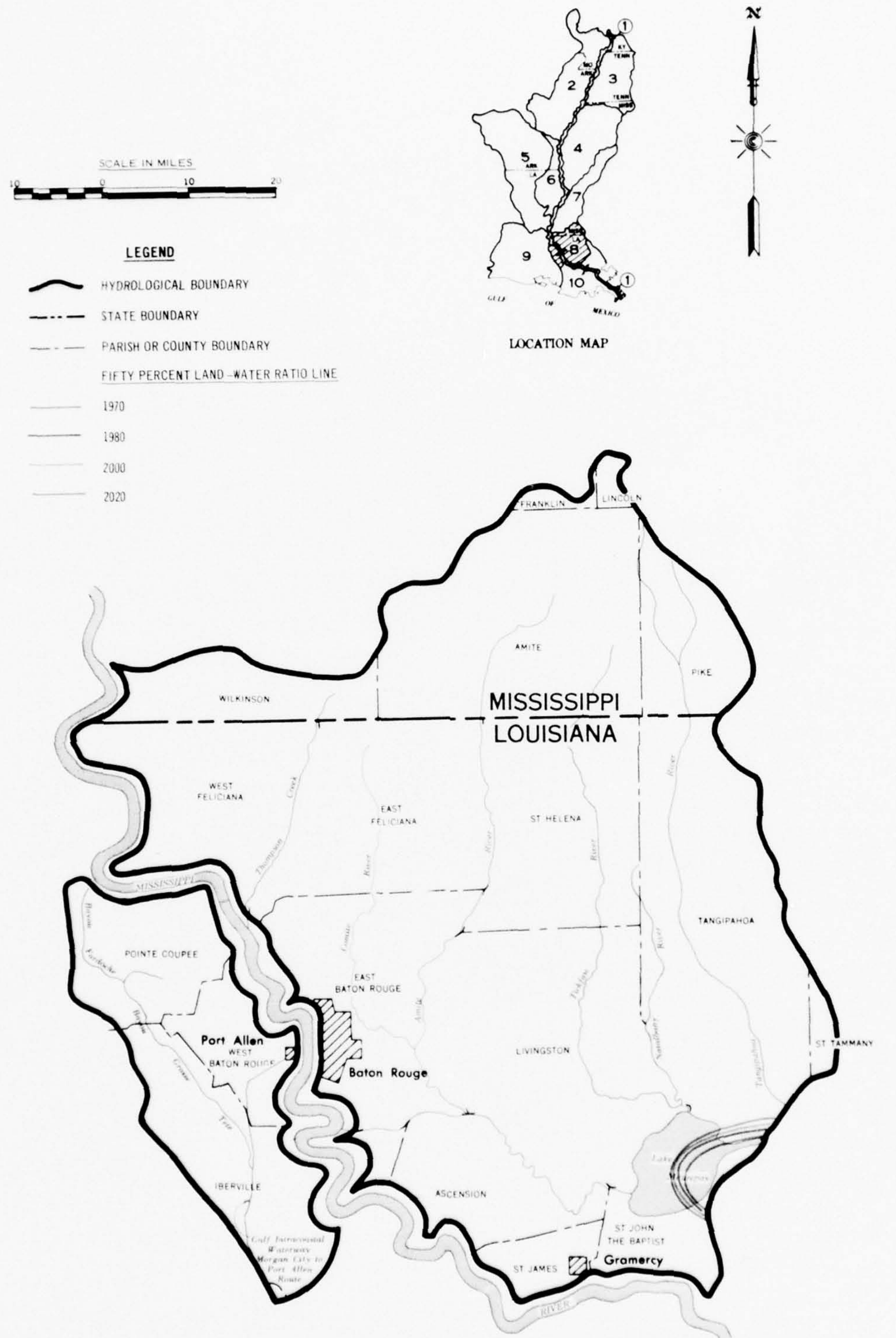
Salinity regimes in the coastal and estuarine zone are satisfactory and will likely remain so. Therefore, no needs for salinity alteration are estimated.

Water Level Management

Water levels in the coastal and estuarine zone are satisfactory and will likely remain so. Therefore, no needs for water-level management are estimated.

Shoreline Erosion

Shoreline erosion in the coastal and estuarine zone is not a major problem; therefore, no needs for shoreline erosion control are estimated.

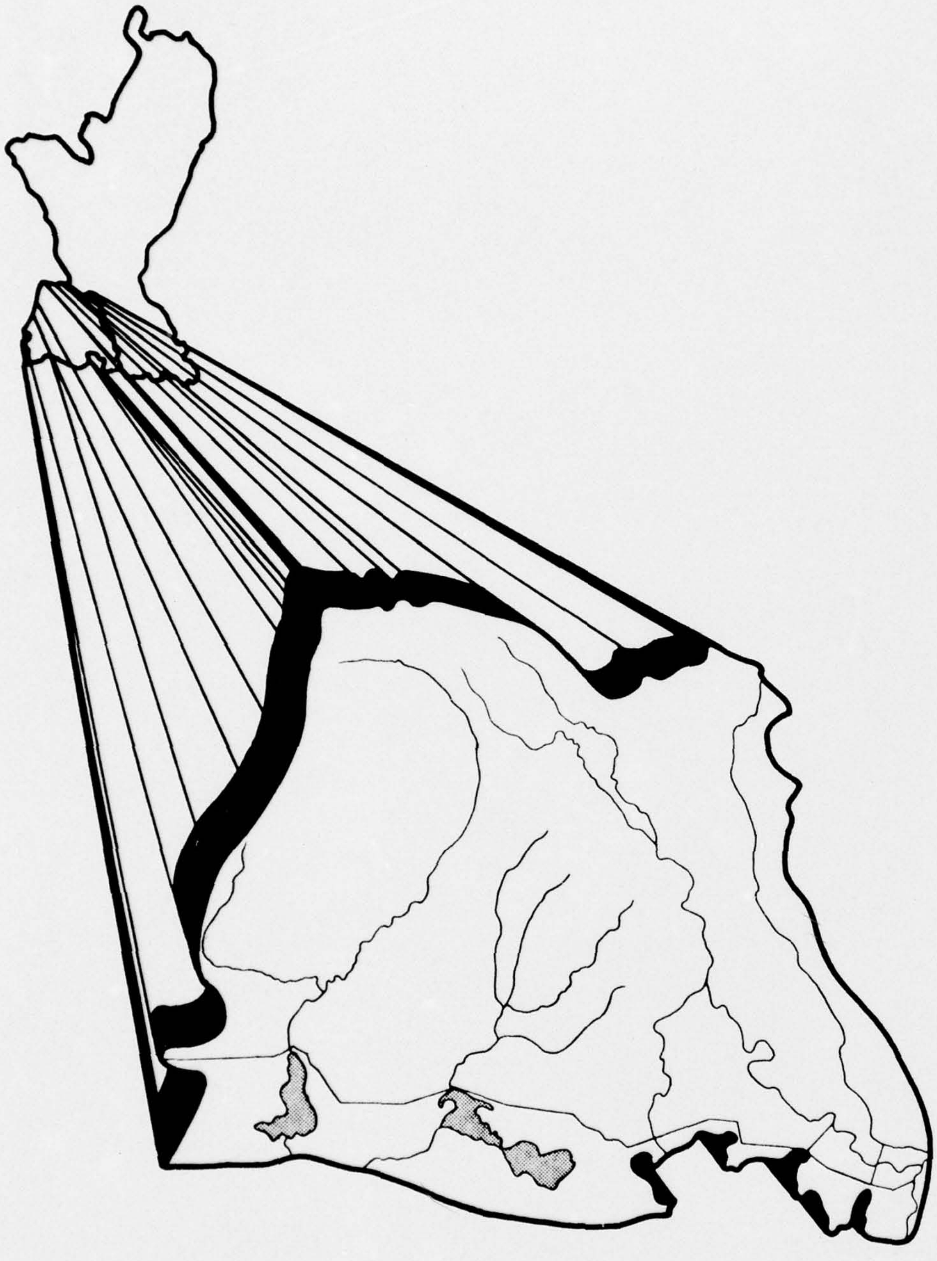


LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

LAND-WATER ISOPLETH

WRPA 8

FIGURE 9



WRPA 9

DESCRIPTION OF COASTAL AND ESTUARINE ENVIRONMENT

Physical

General

The coastal and estuarine zone of WRPA 9 is shown on figure 10. The total land area in the zone is about 2 million acres, comprising about 23 percent of the land area of WRPA 9. Major streams flowing through the zone are the Calcasieu, Mermentau, Vermilion, and Atchafalaya Rivers. The Atchafalaya, a distributary of the Mississippi, transports to the gulf about 30 percent of the annual flow from the 1,243,700 square mile drainage basin of the Mississippi.

Approximately 4,000 to 5,000 years ago, the Mississippi River was building the Teche Delta complex. The river, while occupying this course, deposited large quantities of sediment along the central Louisiana shoreline. Some of the sediments were transported westward by longshore currents and deposited beyond the limits of the delta proper as mudflats along the coastline of Vermilion and eastern Cameron Parishes. About 4,000 years ago, the Mississippi shifted its course eastward with the result that the process of compaction and regional subsidence became dominant along the coastline of WRPA 9. Approximately 3,500 to 3,800 years ago, the Mississippi River shifted its course westward to the Teche course. Once again vast quantities of sediment were deposited along the central Louisiana coastline. As during the earlier stage, prevailing westward longshore currents carried some of the sediments toward the west and deposited them as mudflats along the coastline. Coastal progradation in WRPA 9 continued until approximately 2,800 years ago when once again the Mississippi River shifted its course eastward. About 1,200 years ago another westward shift of the river occurred, and again sediments were transported westward by longshore currents, to be deposited on the coastline of WRPA 9. The Mississippi River shifted eastward to its present course six centureis ago. With this final shift, a deficiency of sediment along the coast of WRPA 9 has resulted in net coastal retreat.

The natural marshes (figure 10) comprise about 864,000 acres or about 43.2 percent of the land area in the zone, within WRPA 9. These marshes extend inland from the Gulf of Mexico for a distance of 20 to 30 miles and, except where narrow "chenieres" or sand ridges occur, are less than 2 feet in elevation above mean sea level. These low-lying marshes were built by deposition of Mississippi River sediment transported by westward gulf currents.

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

COASTAL AND ESTUARINE ZONE

WRPA 9

FIGURE 10

The length of land-water interface below the Gulf Intracoastal Waterway which traverses the area and approximates the landward boundary of marshland is 4,285 miles. This land-water interface is shown on table 10.

Table 10 - Land-Water Interface, Coastal and Estuarine Zone - WRPA 9

	Miles of Interface
Natural Stream Banks	1,154
Lake and Marsh Shoreline	2,157
Excavated Canal Banks	773
Major River Banks	75
Gulf Shoreline	126
Total	4,285

The bay-estuary shoreline consists of 151 miles of sand and 97 miles of mud and/or silt. Calcasieu Lake and Pass and the four major bays are delineated below.

Calcasieu Lake. The shoreline of Calcasieu Lake and the banks of Calcasieu Pass consist of 56 miles of sand beaches and 10 miles of mud and/or silt, the latter located along the east shoreline of the lake and along the banks of Calcasieu Pass.

Vermilion Bay. The western shore of Vermilion Bay consists of a series of discontinuous sand beaches with localized concentrations of shell material. Generally, the shoreline between the sand beaches consists of silt accumulations. The northern shore of Vermilion Bay is predominantly mud and/or silt. Along the eastern perimeter of Vermilion Bay, the predominant shoreline type is mud overlain by extensive deposits of black, organic flakes and particles referred to by the local inhabitants as "coffee grounds."

West Cote Blanche Bay. The south shoreline of West Cote Blanche Bay along Marsh Island is predominantly mud and silt with locally thick accumulations of clamshells forming small beaches. The northwestern shoreline of West Cote Blanche Bay, from Cypremort Point to Cote Blanche

Island consists generally of alternating reaches where local concentrations of shell material predominate. South of Little Bay, "coffee grounds" blanket much of the shoreline to the general vicinity of Marone Point.

East Cote Blanche Bay. Along the shore of East Cote Blanche Bay, between Marone Point and Point Chevreuil, sand beaches predominate. A small concentration of silt and mud exists in the vicinity of Salt Point.

Atchafalaya Bay. The beaches around Atchafalaya Bay generally consist of ridges 2 to 3 feet high, varying in width from 25 to 100 feet, composed of shells and shell fragments concentrated by wave action. Organic flakes and particles are at times found resting on the beachfront.

Climate

The climate of WRPA 9 is characterized by mild winters, hot summers, and relatively heavy precipitation. The normal annual temperature is 68.3° F. The normal annual precipitation, based on 30 years of record, is 59.3 inches. Major storms are associated with hurricanes and the passage of extra-tropical cyclones. In summer, convective thundershowers produce intense, but highly localized rainfall.

Hurricanes and lesser tropical storms generate tidal surges which raise tides far above the elevation of the shoreline, resulting in the inundation of the marshlands and other low-lying land. The high storm tides and storm-swept waves subject the shoreline to erosive attack. The Standard Project Hurricane, traveling on a critical track, would be accompanied by a hurricane surge varying from 11 to nearly 14 feet in elevation near the shoreline, and to lesser elevations inshore.

Socioeconomic and Cultural

Population

The 1970 population of that portion of the coastal and estuarine zone in WRPA 9 was about 65,000, or less than 10 percent of the population of the WRPA. From 1940 to 1960 population in the zone increased 5 percent, while the population of WRPA 9 increased 41 percent. However, in the last decade, population in the coastal zone increased 20 percent, as compared to 11 percent for the WRPA.

Population of the coastal and estuarine zone is projected to number 87,300 by 2020 under the National Income objective and to 97,300 by 2020 under the Regional Development objective.

Economic Activities

The economy of the coastal and estuarine zone of WRPA 9 is based upon an abundance of natural mineral deposits, agriculture, and fish and wildlife resources. Oil and gas fields are located throughout the land area and offshore in the Gulf of Mexico. Salt, sulphur, and sand and gravel are other economically important minerals produced in the zone. The value of mineral production aggregated for the four coastal parishes in WRPA 9 inclusive of offshore production, amounted to $1,291.4 million in 1970. Sugarcane, rice, and soybeans are the principal crops. The value of farm products sold in the four coastal parishes for the year 1969 was over $47.1 million. The coastal marshes, bays, and the gulf comprise an extensive fishery resource in both fresh water and euryhaline species. The commercial fisheries harvest during the period 1963 to 1967 was nearly 453 million pounds valued at a yearly average of $19 million.

In the coastal parishes of Cameron, Vermilion, Iberia, and St. Mary, employment has drastically fallen in the agricultural, forestry, and fisheries sector. During the period 1950 to 1960 employment in this sector decreased from 10,700 to 5,800, which represented a decrease of nearly 46 percent. Substantial increases in employment have accrued in the sectors of mining, wholesale and retail trade, and services. The largest gain during the period 1950 to 1960 was in services where employment increased from 5,233 to 9,599. The wholesale and retail trade sector had the second largest gain in employment with an increase from 6,135 in 1950 to 8,628 in 1960. The mining sector had the third largest increase from 3,166 in 1950 to 5,154 in 1960.

Land ownership within the coastal and estuarine zone is largely private. Water bottoms are generally State-owned. A number of wildlife refuges and game management areas involving some degree of government control are located throughout the area.

COASTAL AND ESTUARINE PROBLEMS AND NEEDS

General

The specific water resource development needs of the coastal and estuarine zone of WRPA 9 are discussed below.

Land-Water Ratio

The coastal and estuarine zone has been experiencing land loss at a rate of 3.4 square miles per year (figure 11). However, the pendency of a major hydrographic event in Atchafalaya Basin will bring about significant change. For the past 40 years or so, the vast open water areas of Grand and Six Mile Lakes have acted as a trap for sediments transported by the Atchafalaya River, with the result that major land gains have been occurring in these areas. The lakes are now, however, largely filled, and new lands will soon begin to appear in Atchafalaya Bay as the sediments passing through the channels in the filled lakes reach the shallow waters of the bay. The resultant deltaic progradation will likely reduce the net rate of land loss in the coastal and estuarine zone of WRPA 9 by about one-half. Therefore, the net land loss in WRPA 9 approximates 1.7 square miles per year. To offset this land loss in WRPA 9, an equivalent land-building need exists in the Louisiana coastal and estuarine zone to maintain a dynamic near-equilibrium in land loss-land gain (table 4). In terms of Mississippi River discharge, the flow required to meet this land-building need is 23,000 c.f.s. (14,900 m.g.d.).

Salinity Alteration

Salinity regimens in the coastal and estuarine zone have experienced general changes during the past several decades. During this time, the bays have undergone a gradual decrease in salinity due to increased diversions of Mississippi River flow into the Atchafalaya River. The salinity regimen in the Grand Lake-White Lake area has been subjected to regulation and control in the interest of agricultural water supply. In this area, the incorporation of structures to prevent salt-water intrusion, and the adoption of certain marsh management practices on wildlife refuges have operated to reduce average salinities. In Calcasieu Pass, Calcasieu Lake, and Calcasieu River, salinities have been drastically increased by construction of the deep water (40-foot) navigation channel between the Gulf of Mexico and the port of Lake Charles, Louisiana. Addition of a salt-water barrier structure above Lake Charles has, however, provided an effective means of controlling salt-water intrusion above its location.

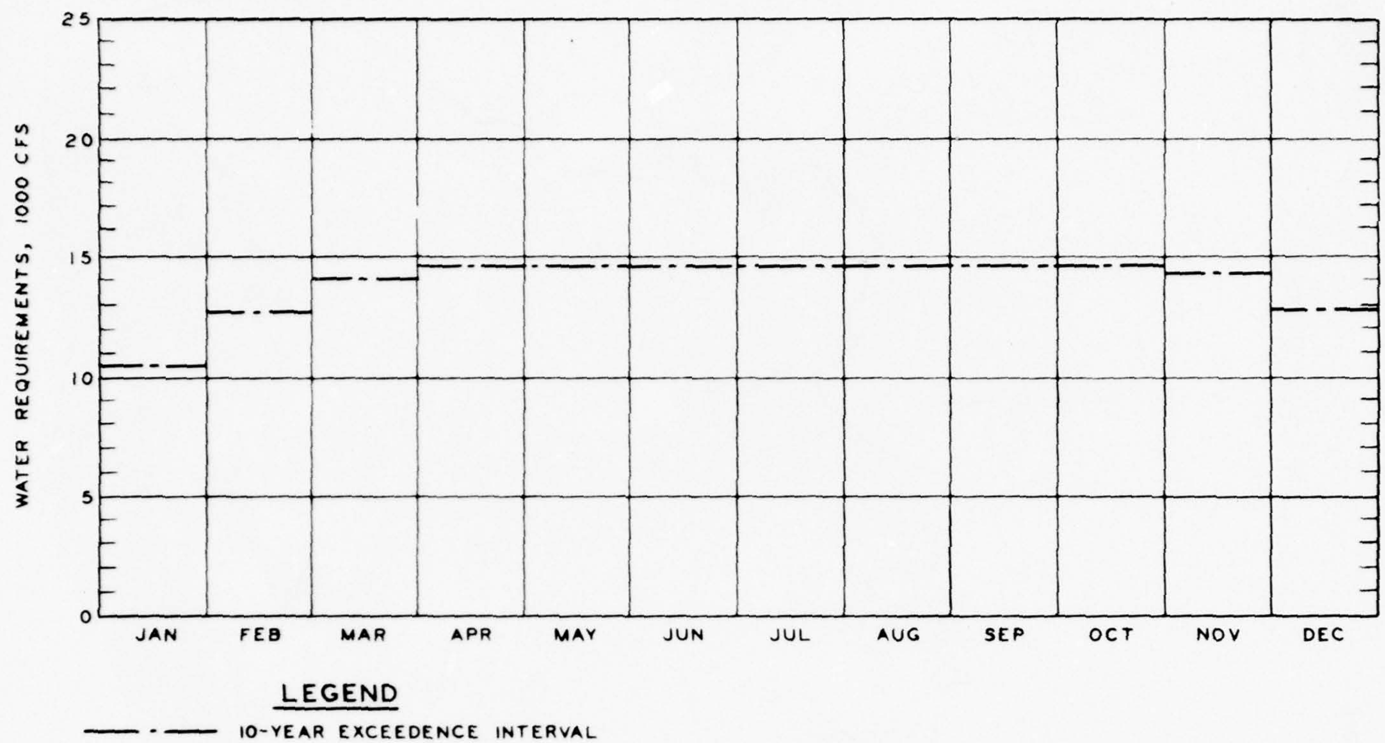
Salinity regimens in all parts of the coastal and estuarine zone except Calcasieu Lake are satisfactory and will likely remain so. The estimated fresh-water needs for Calcasieu Lake are shown on figure 12 and in table 11.

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

LAND-WATER ISOPLETH

WRPA 9

FIGURE 11



ESTIMATED WATER NEEDS
FOR SALINITY ALTERATION
CALCASIEU LAKE

FIGURE 12

Table 11 - Estimated Water Needs for Salinity Alteration, Coastal and Estuarine Zone - WRPA 9

Location	Mississippi River Flow (c.f.s.)	Mississippi River Flow (m.g.d.)
Calcasieu Lake	13,800	8,900
Total	13,800	8,900

Water Level Management

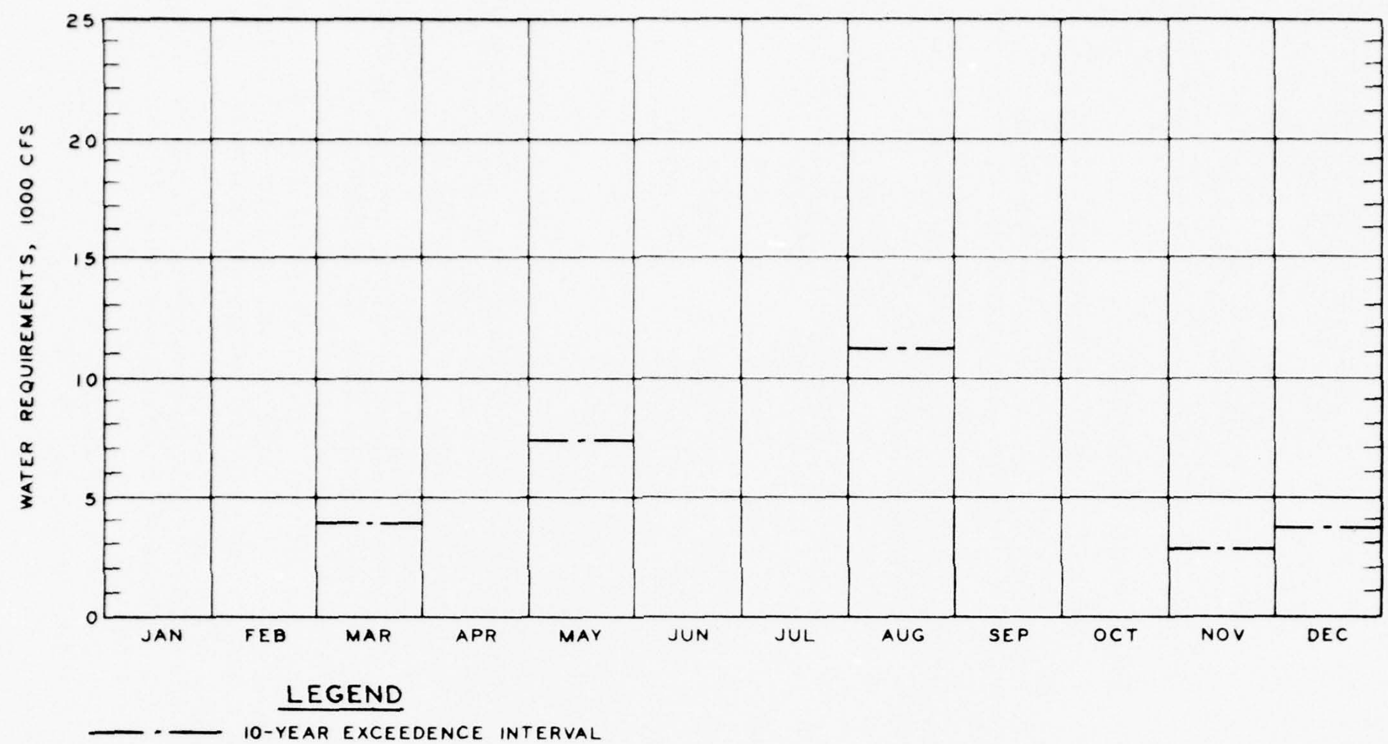
Supplemental water to maximize estuarine productivity in WRPA 9 is satisfactory in all areas except in the Grand-White Lake area and in the Atchafalaya Floodway. Supplemental water needs for these areas are shown on figures 13, 14, and 15 and in table 12.

Table 12 - Estimated Water Needs for Water Level Management, Coastal and Estuarine Zone - WRPA 9

Location	Mississippi River Flow (c.f.s.)	Mississippi River Flow (m.g.d.)
Grand-White Lake Area	2,400	1,600
Atchafalaya Floodway	89,800	58,000
Total	92,200	59,600

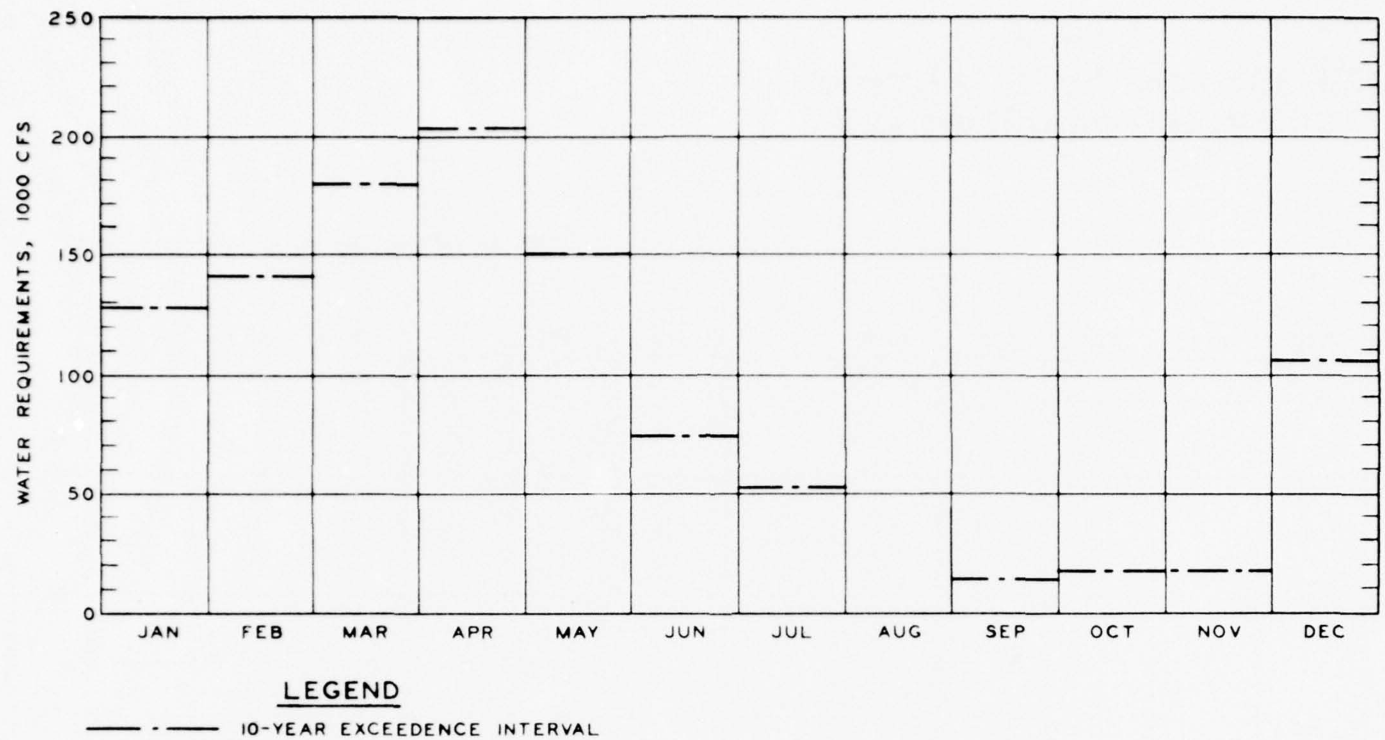
Shoreline Erosion

Serious erosion is occurring in WRPA 9 along the gulf shoreline that parallels Highway 82, between Peveto and Holly Beaches. This section of highway is unique in that it is one of the only sections of highway in Louisiana that runs immediately adjacent to the Gulf of Mexico. Its scenic quality makes it an outstanding area for recreation and aesthetic pursuits. Consideration of relevant factors in halting erosion in this area based on a recent survey report by the Corps of Engineers indicates that management to prevent or minimize adverse effects may be more appropriate than action to halt erosion. The conclusions drawn from the study were that maintaining the road in its present location by halting erosion would require a heavy stone revetment which was determined economically unjustified, while relocation of the road landward would require a much less aesthetically offensive revetment. Therefore, this reach of shoreline is not included in the estimated needs to protect critically eroding shorelines and no others exist in WRPA 9. Figures 16 and 17 show the shoreline and shoreline changes for WRPA 9. For a detailed description of shoreline erosion in WRPA 9, see "National Shoreline Study, Inventory Report - Lower Mississippi Region," U.S. Army Corps of Engineers, July 1971.



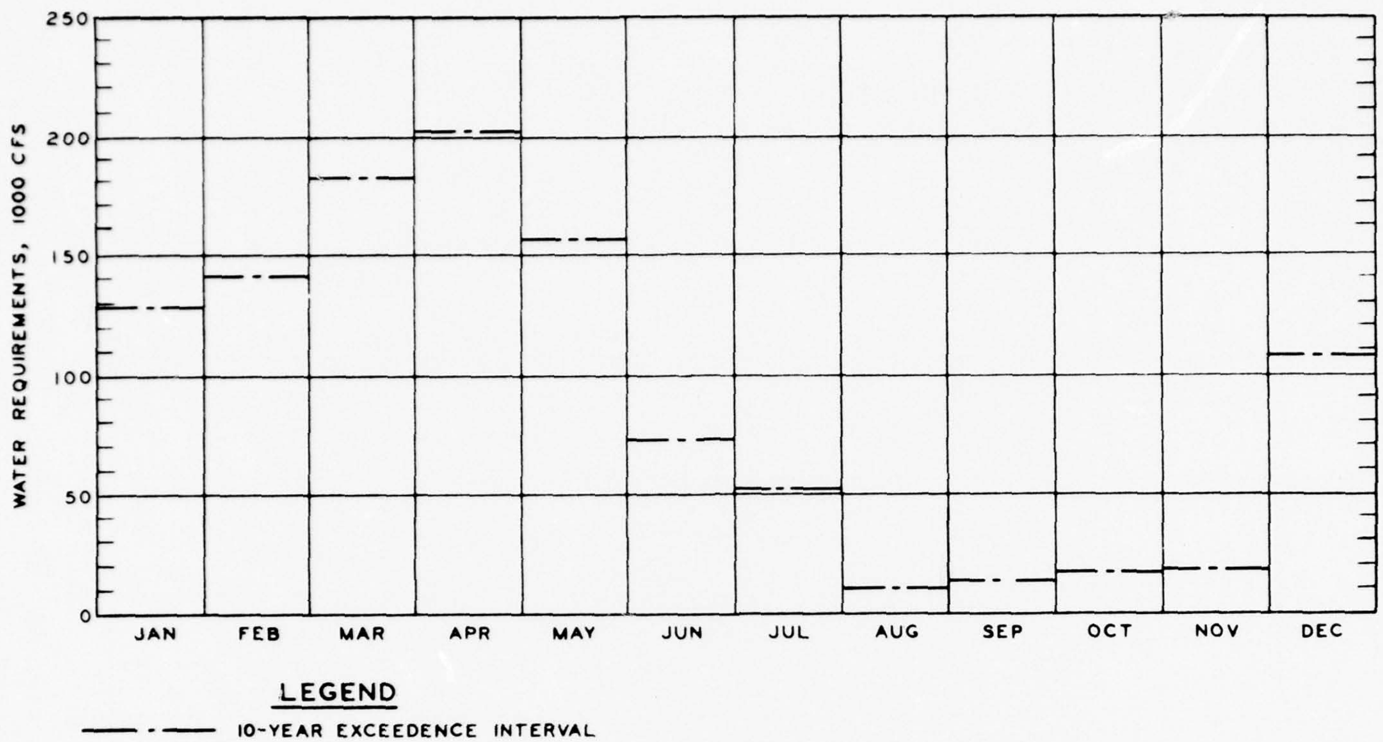
ESTIMATED WATER NEEDS
FOR WATER LEVEL MANAGEMENT
GRAND AND WHITE LAKE AREA

FIGURE 13



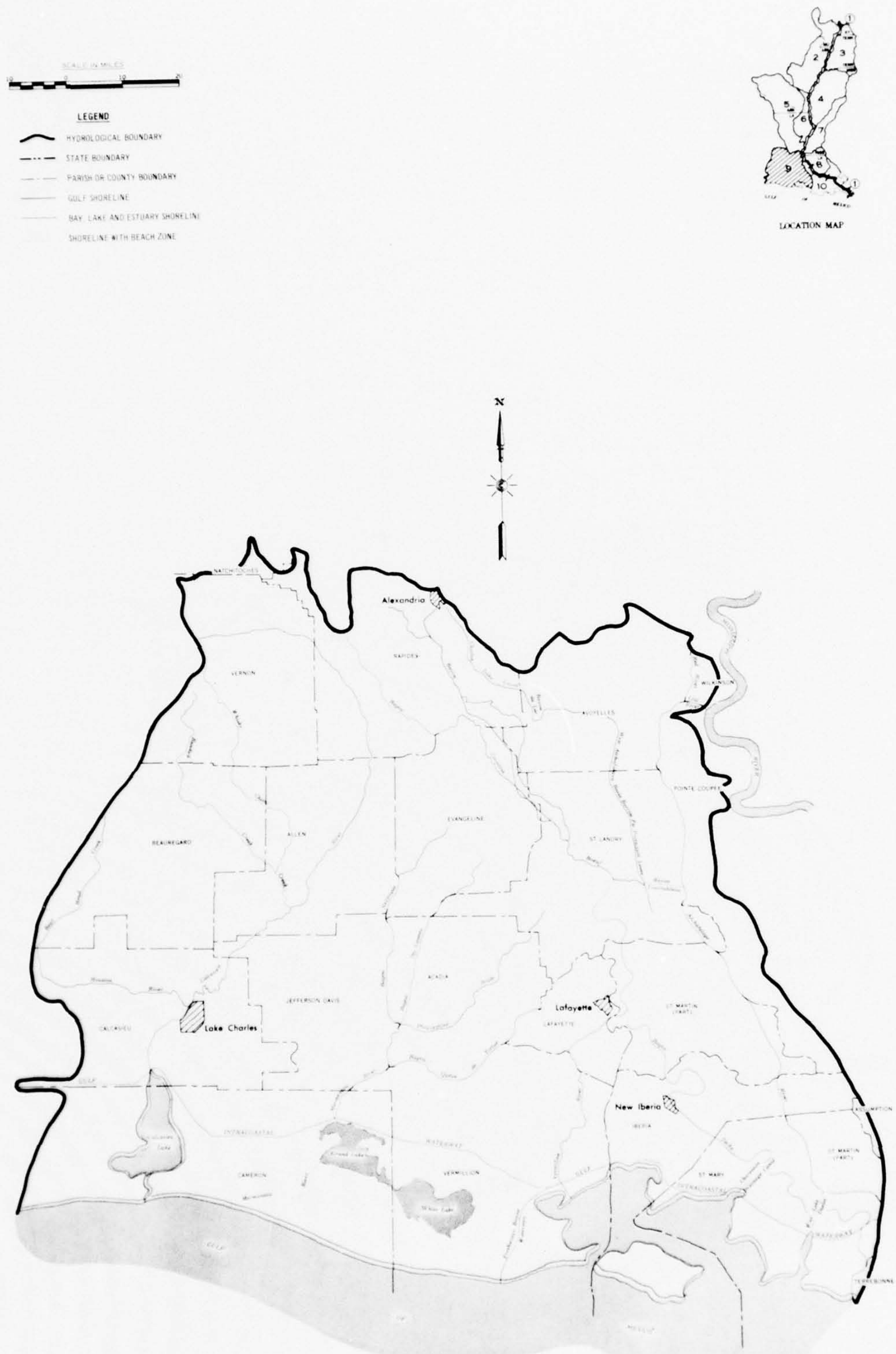
ESTIMATED WATER NEEDS
FOR WATER LEVEL MANAGEMENT
ATCHAFALAYA FLOODWAY

FIGURE 14



ESTIMATED WATER NEEDS
FOR WATER LEVEL MANAGEMENT
WRPA 9

FIGURE 15



LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

SHORELINE CHARACTERISTICS

WRPA 9

FIGURE 16

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

HISTORICAL SHORE CHANGES

WRPA 9

FIGURE 17

WRPA 10

W R P A 10

DESCRIPTION OF COASTAL AND ESTUARINE ENVIRONMENT

Physical

General

The coastal and estuarine zone of WRPA 10 is shown on figure 18. The total land area in the zone is about 2.3 million acres, comprising about 47 percent of the land area of WRPA 10. Major streams flowing through the zone to the Gulf of Mexico are the Mississippi River, Bayou Lafourche, and the Mississippi River-Gulf Outlet. The Gulf Intracoastal Waterway traverses the zone and numerous small lakes, bayous, and canals form a labyrinthe waterway network in the area. The Mississippi River is by far the most prominent stream in the area, and Lake Pontchartrain is the largest lake.

About 4,000 years ago, the Mississippi began building the Cocodrie delta by depositing its sediment in the vicinity of Lake Pontchartrain. Approximately 3,500 to 3,800 years ago, the Mississippi River shifted its course westward to the Teche course, causing general deterioration of the Cocodrie delta mass in the northeastern part of WRPA 10, near Lake Pontchartrain. Approximately 2,800 years ago, the Mississippi River again shifted its course to occupy the St. Bernard course, and began developing a vast delta in WRPA 10, extending from the general vicinity of Barataria Bay eastward into the gulf beyond the current position of the Chandeleur Island group. Approximately 1,200 years ago, the Mississippi River again shifted its course westward, causing the Lafourche delta to begin building and the shoreline, in the vicinity of Lafourche and Terrebonne Parishes, to advance seaward. Deterioration of the abandoned St. Bernard delta occurred concurrently with the build-up of the Lafourche delta. The Breton and Chandeleur Island groups represent a late stage in deltaic destruction resulting from subsidence behind the old shoreline and reworking of the ends of numerous old distributaries. Six hundred years later the Mississippi River abandoned the Lafourche course in favor of its present course.

Natural marshes (figure 18) comprise about 1,507,000 acres or about 65.5 percent of the land area in the coastal and estuarine zone of WRPA 10. These marshes extend inland from the Gulf of Mexico for a distance of between 20 and 35 miles. The marshes are low-lying areas, usually less than 3 feet in elevation above mean sea level, built with sediment deposited by the Mississippi River.

The length of land-water interface which traverses the zone approximating the landward boundary of marshlands is 26,215 miles. This land-water interface is shown in table 13.

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

COASTAL AND ESTUARINE ZONE

WRPA 10

FIGURE 18

Table 13 - Land-Water Interface, Coastal and Estuarine Zone - WRPA 10

	Miles of Interface
Natural Stream Banks	5,971
Lake and Marsh Shoreline	14,525
Excavated Canal Banks	4,737
Major River Banks	307
Gulf Shoreline	675
Total	26,215

The shoreline along the bays, lakes, and estuaries consisting of 304 miles of sand and 551 miles of mud and/or silt is described below:

Fourleague Bay, located at the southwestern extremity of WRPA 10 consists predominantly of mud and silty material derived from reworking of the surrounding marshes, and from sediments transported into the bay from the Atchafalaya River.

From Fourleague Bay eastward to Bastian Bay, 42 percent of the bay-sound shoreline consists of sand beaches and 58 percent consists of mud and/or silt. The sand beaches generally contain only a surface veneer of sand a few inches to a foot thick overlying soft marsh deposits. In the general vicinity of Pelican Lake a mud shoreline has developed from enlargement of the lake within the marsh. Sand beaches predominate along the shoreline of Lake Pelto from Pelican Lake to Bayou Petit Caillou. The source of most of the sand is the reworking of the coarser natural levee deposits and abandoned distributary material of Bayou Petit Caillou. Mud and/or silt shorelines are the primary type shoreline along the western shore of Terrebonne Bay to the vicinity of Bayou Terrebonne, the result of reworking of the marsh deposits. Very small localized beaches are scattered throughout this reach. From Bayou Terrebonne, around the shorelines of Lake Barre, Lake Felicity, and Lake Raccourci, the primary shoreline material is sand derived from the reworking of sediments deposited by Bayou Terrebonne when it was active in the area. Within this area, there are two localized shell beaches, one along the northern shore of Lake Barre, and the other along the northeastern shoreline of Lake Raccourci. The remaining eastern shoreline of Timbalier Bay is predominantly mud and/or silt. The bay-sound shoreline paralleling the leeward edge of the barrier islands of Isles

Dernieres, Timbalier, and East Timbalier consists primarily of sandy material. The shoreline around Caminada Bay, Barataria Bay, and smaller adjacent bays is mainly mud and/or silt, with small localized shell beaches along the northern shoreline of Barataria Bay. The remaining bay-sound shoreline in this reach is almost entirely mud and/or silt, with a scattering of sand beaches concentrated around the shoreline of Bastian Bay. The sand material is derived from a reworking of material deposited by Grand Bayou.

Between Bastian Bay and the Main Pass of the Mississippi River the bay-sound area includes the bank lines of Southwest Pass, South Pass, Pass a Loutre, and Main Pass, and is composed entirely of mud and/or silt deposited by the Mississippi River.

Between Main Pass and Isle au Pitre the area is characterized by an extremely irregular and heavily indented zone of bays along the mainland, and a lack of bay-sound shoreline.

West of Isle au Pitre the bay-sound shoreline consists of 46 percent sand beaches and 54 percent mud and/or silt around Lakes Borgne, St. Catherine, and Pontchartrain, including Chef Menteur Pass and the Rigolets to the mouth of the Pearl River. Along the eastern shoreline of Lake Borgne from Malheureux Point to Pointe Aux Marchettes, the predominant shoreline material is mud and/or silt derived from reworking of the surrounding marshlands. From Pointe Aux Marchettes to the mouth of Bayou Bienvenue, a sand beach exists except for a small section of mud and/or silt and small local concentrations of shell material which overlap part of the sandy beaches. The sand is derived from a reworking of sediments deposited by old distributaries and the shell from destruction of shell middens. The remaining shoreline of Lake Borgne from Bayou Bienvenue to Pearl River is predominantly mud and/or silt, with only minor amounts of sand located between the Rigolets and the Pearl River. The banks of the Rigolets and Chef Menteur Pass, and the shoreline of Lake St.Catherine, are composed entirely of mud and/or silt derived from surrounding marshlands. From the Rigolets west to Pointe aux Herbes intermittent shore types from sand to mud exist, and from Pointe aux Herbes to the general vicinity of Lincoln Beach, sand predominates. Around Pointe aux Herbes, several small beaches are recognizable. The abundance of sand south of Pointe aux Herbes and the existence of shell material is attributed to the reworking of the materials of old distributaries. Along the shoreline of Lake Pontchartrain, from Lincoln Beach to New Orleans Airport, mud and/or silt are predominant. The shoreline between the New Orleans Airport and the Jefferson-Orleans Parish line is protected by a concrete seawall with lakeward beaches at two locations and from the Jefferson-Orleans Parish line to the Jefferson-St. Charles Parish line by a revetment of asphalt and riprap. From the Jefferson-St. Charles Parish line to the vicinity of the Tangipahoa River in the northwest corner of Lake Pontchartrain a few small, discontinuous beaches of fine sand and shell exist. Generally, the sand material results from destruction of some former ridge left behind by a retreating shoreline, while the shells are the result of natural concentration by wave action

from deposits on the lake bottom or from destroyed shell middens. In the vicinity of the Tangipahoa and Tchefuncta Rivers, small localized shell beaches have developed. In addition, just west of the Tchefuncta River a small sand beach has developed, the result of a reworking of onshore materials primarily from Miltons Island. The remaining bay-sound shoreline extends from the Tchefuncta River eastward to the Rigolets and consists predominantly of sand with minor amounts of mud and/or silt. The primary source of the sand has been the reworked Pleistocene material brought into the area by streams flowing off the Pleistocene terraces into Lake Pontchartrain. Another source of the sand is the submerged Milton Island beach (averaging about 2,000 feet in width) which parallels the northern shoreline 3 to 6 miles offshore and comes onshore in the vicinity of Bayou Lacombe.

Climate

The climate of WRPA 10 is characterized by mild winters, hot summers, and relatively heavy precipitation. The average annual temperature is 69° F. The average annual precipitation, based on 30 years of record, is 62.6 inches. Major storms affecting this area are associated with tropical hurricanes and extra-tropical cyclones. Convective thundershowers during the summer months produce intense but highly localized rainfall.

Tropical hurricanes and lesser tropical storms generate tidal surges which raise tides far inland and result in the inundation of marshlands and lowlands. The hurricane storm tides and storm waves cause erosive attack upon the shoreline. The Standard Project Hurricane, traveling on a critical track, would be accompanied by a hurricane surge of from 11 to nearly 14 feet in elevation near the shoreline, and to lesser elevations inshore.

Socioeconomic and Cultural

Population

The 1970 population of the coastal and estuarine zone in WRPA 10 was approximately 214,000, or slightly more than 16 percent of the population of the WRPA. The population of both the coastal zone and the entire WRPA increased about 55 percent from 1940 to 1960. During the last decade, however, population in the coastal zone increased 31 percent, as compared to 17 percent for the entire WRPA.

The population of the coastal and estuarine zone is projected to reach 390,000 by 2020 under the National Income objective and to 443,000 by 2020 under the Regional Development objective.

Economic Activities

The economy of the coastal and estuarine zone is based upon an abundance of natural mineral deposits, fish and wildlife resources, and

some agriculture - primarily in Terrebonne and Lafourche Parishes. Petroleum and natural gas fields are located throughout the land area and offshore in the Gulf of Mexico. Natural gas liquids, sulfur, sand, and gravel are other economically important minerals produced in the zone. The aggregate value of mineral production for the five coastal parishes in WRPA 10 inclusive of the offshore productions amounted to over $2,779.3 million in 1970. Sugarcane is by far the most important agricultural product. The value of all farm products sold in the five coastal parishes totaled $13.9 million in 1969. The coastal marshes, bays, and the gulf comprise an extensive fishery containing both fresh water and euryhaline species. According to a report by the National Marine Fisheries Service, based on data for the period 1963 to 1967, the average yearly value of fish and shellfish landed in the five coastal parishes of WRPA 10 totaled $41 million.

COASTAL AND ESTUARINE PROBLEMS AND NEEDS

General

The specific water resource development needs fo the coastal and estuarine zone of WRPA 10 are discussed below.

Land-Water Ratio

The coastal and estuarine zone has been experiencing land loss at the rate of 13.0 square miles per year (figure 19). This land loss approximates 80 percent of the total land loss occurring in coastal Louisiana. To offset this land loss in WRPA 10, an equivalent land-building need exists in the Louisiana Coastal and Estuarine zone to maintain a dynamic near-equilibrium in land loss-land gain (table 4). In terms of Mississippi River discharge, the flow required to meet this land building need is 522,000 c.f.s. (337,300 m.g.d.).

Salinity Alteration

In the past several decades, general increases in salinity have been experienced in all of the coastal zone except the area adjacent to the lower 25 miles of the Mississippi River Delta. The increased salinities are principally attributed to canal dredging and stream channelization, which have provided avenues for the intrusion of the highly saline waters of the Gulf of Mexico.

By comparing a map showing vegetative types existing during the period 1941 to 1945[1/] with similar map dated 1968[2/] it was determined that the saline zone in WRPA 10 has moved inland an average distance of 2.1 miles, while the brackish marsh zone has extended inland for an average distance of 3.8 miles, and increased in width by 1.7 miles. Future increased salinities and tidal cycling are expected to enlarge the saline and brackish marsh zones at the expense of fresh and intermediate marshes.

Salinity regimens are high in all of the estuarine and coastal zone with the exception of the extreme lower end of the Mississippi Delta. The Ad Hoc Interagency[3/] group developed estimates of fresh water needed to maintain salinity regimens at a level which would maximize estuarine productivity. The fresh water needs to maintain the 15 parts per thousand (p.p.t.) mean salinity isohaline (figure 3) in terms of the Mississippi River flow below Old River are shown on figures 20, 21, 22, 23, 24, and in table 14.

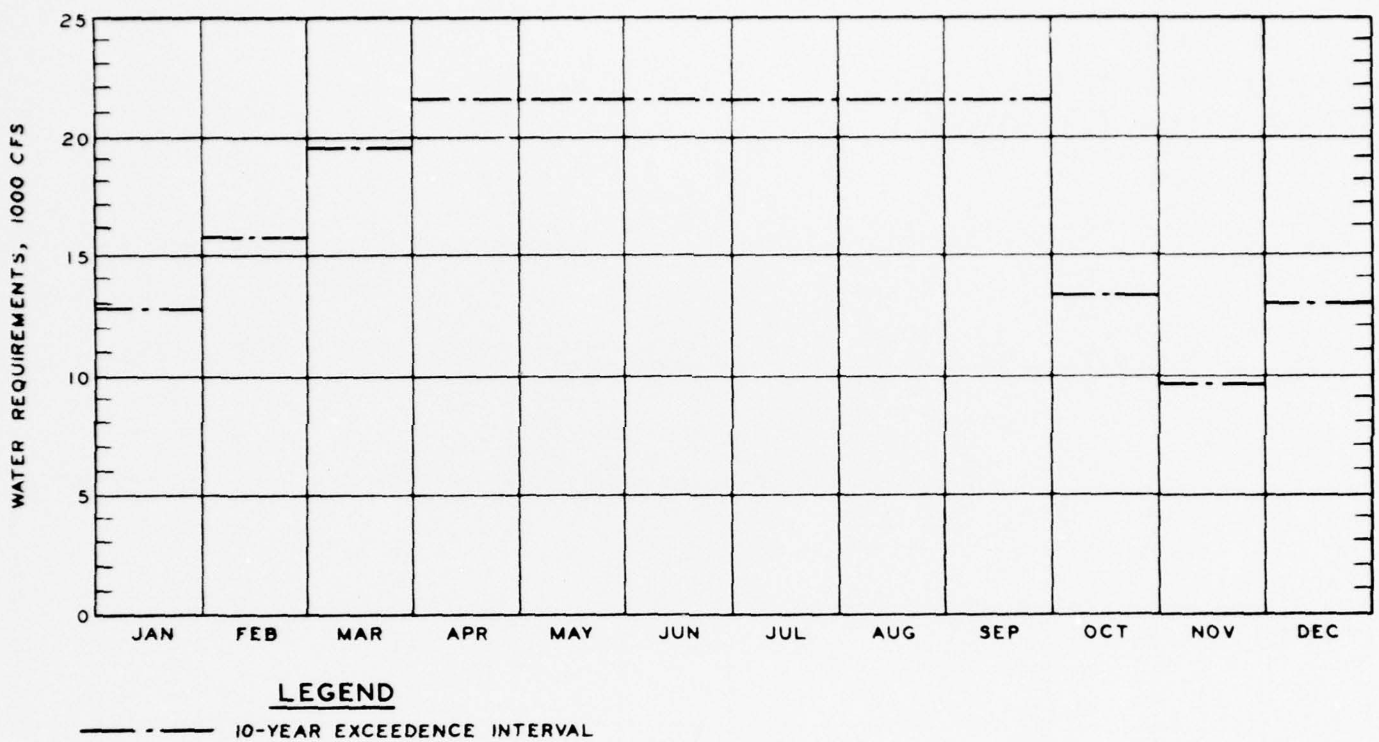
1/ See footnote 3 on p. 13
2/ See footnote 4 on p. 13
3/ See footnote 2 on p. 8

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

LAND-WATER ISOPLETH

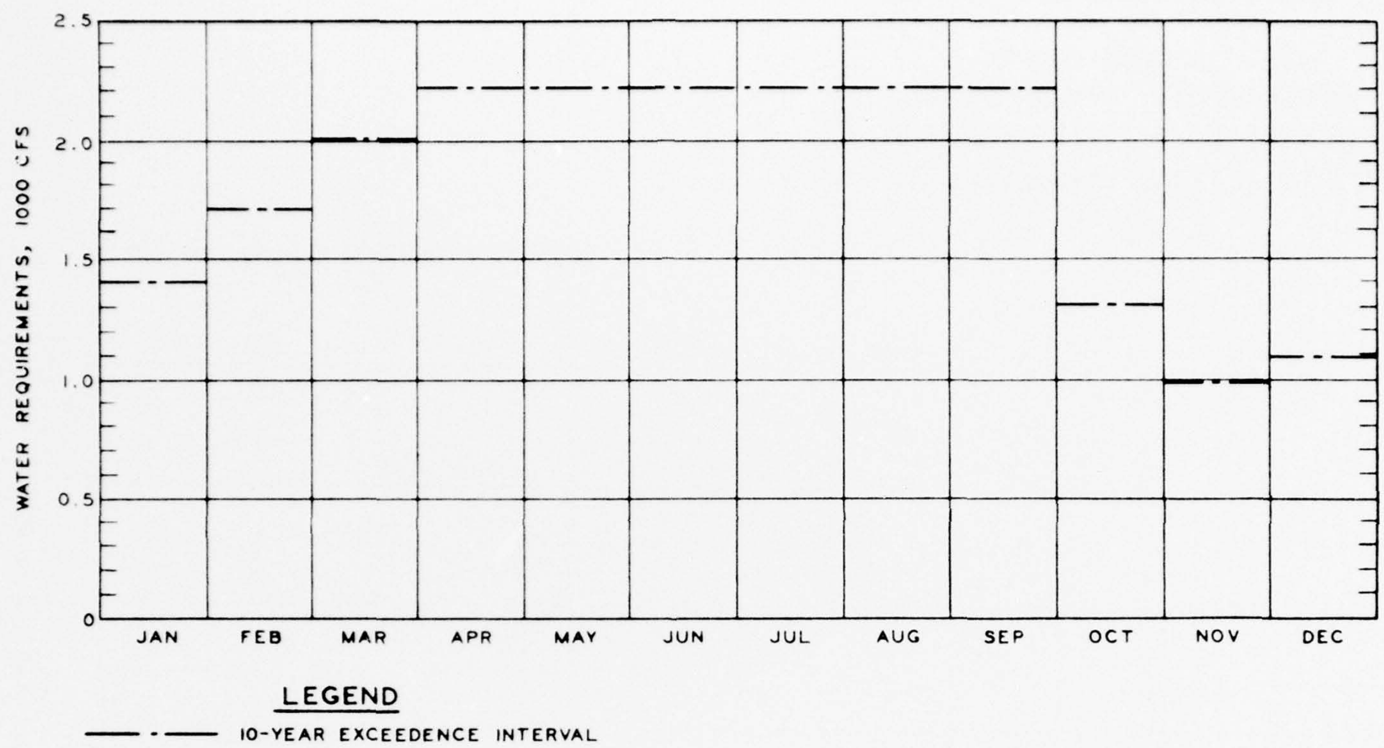
WRPA 10

FIGURE 19



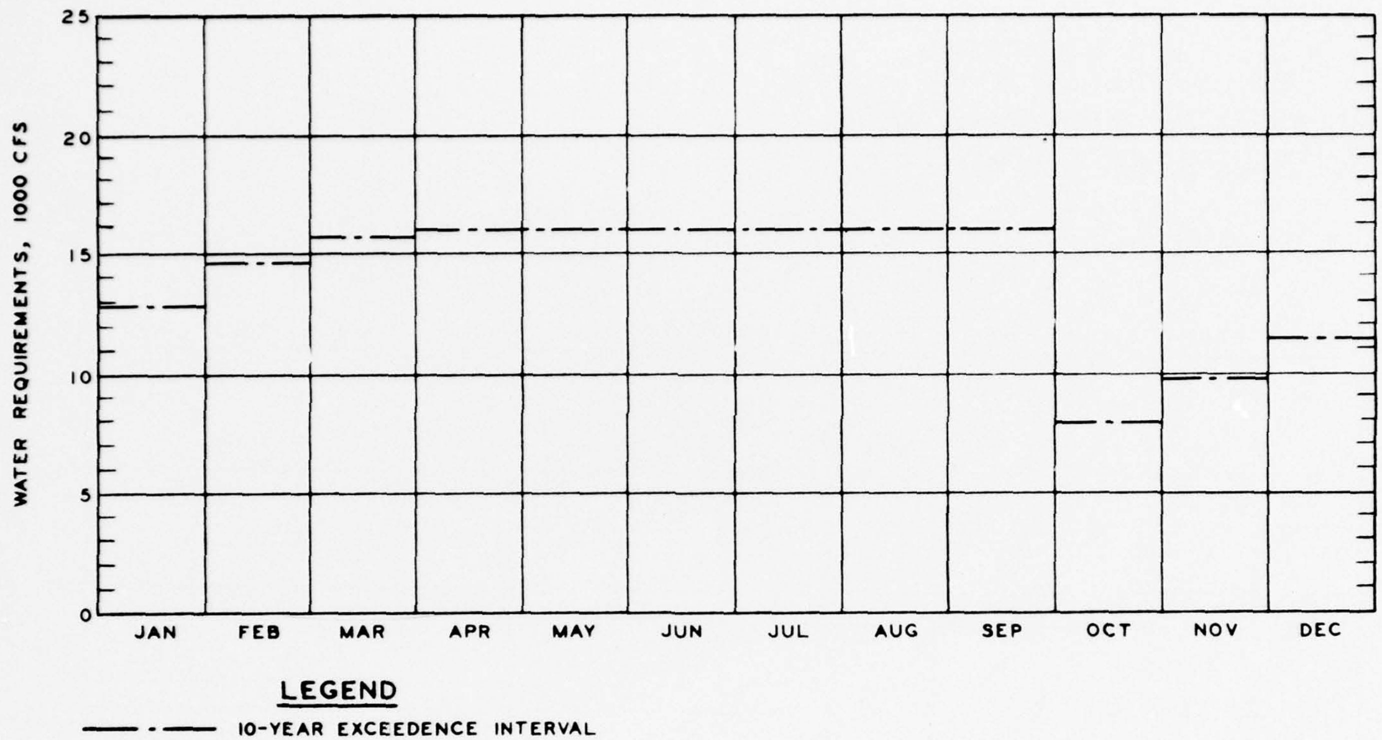
ESTIMATED WATER NEEDS
FOR SALINITY ALTERATION
LAKE PONTCHARTRAIN–
LAKE BORGNE AREA

FIGURE 20



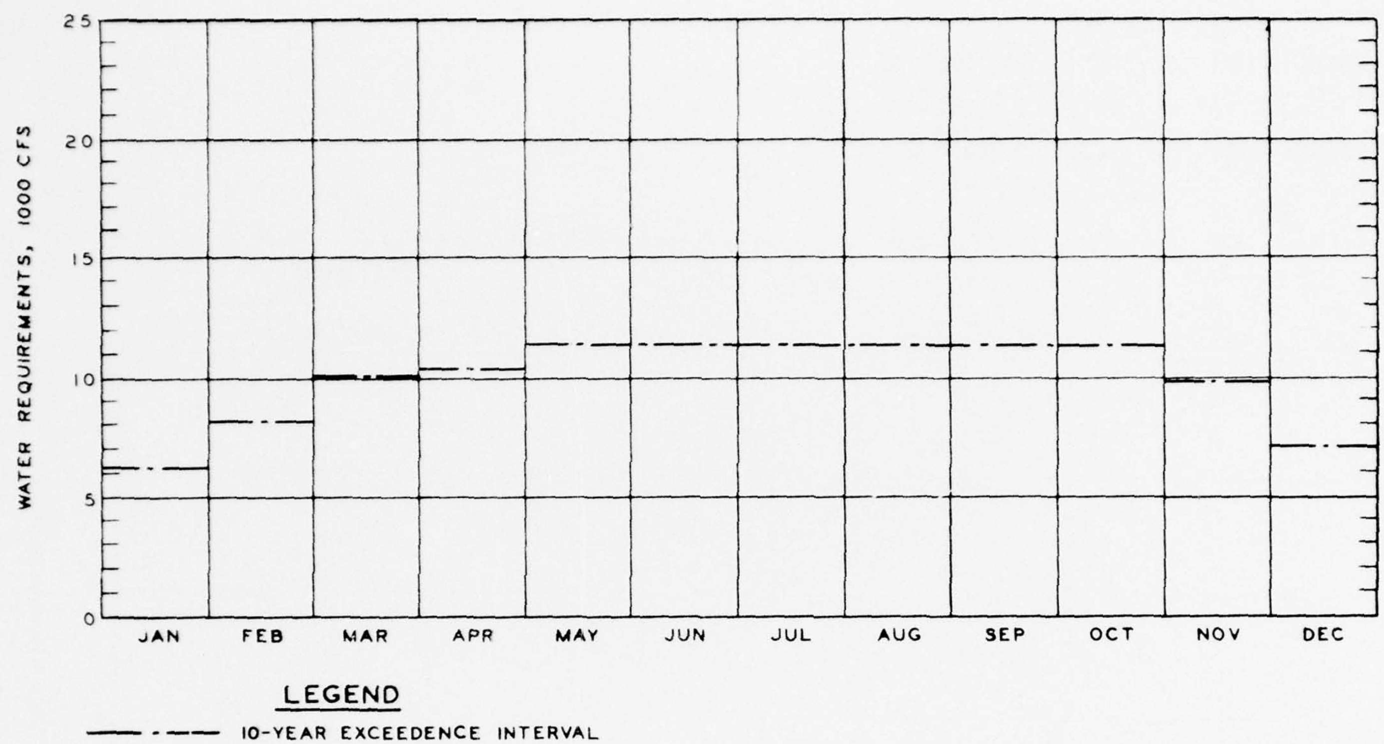
ESTIMATED WATER NEEDS
FOR SALINITY ALTERATION
BRETON SOUND AREA

FIGURE 21



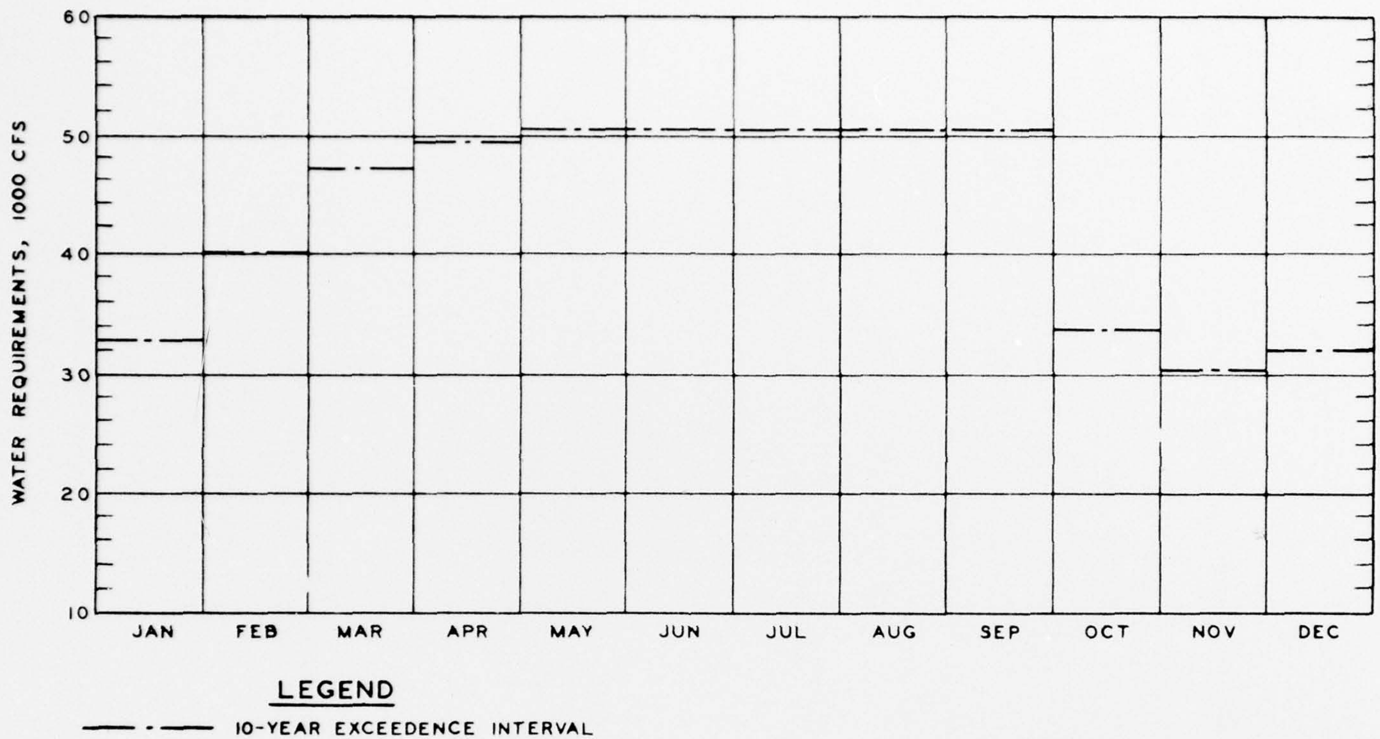
ESTIMATED WATER NEEDS
FOR SALINITY ALTERATION
CAMINADA-BARATARIA-BASTIAN
BAYS AREA

FIGURE 22



ESTIMATED WATER NEEDS FOR SALINITY ALTERATION
CALLIOU-TERREBONE-TIMBALIER BAYS AREA

FIGURE 23



ESTIMATED WATER NEEDS
FOR SALINITY ALTERATION
WRPA 10

FIGURE 24

Table 14 - Estimated Water Needs for Salinity Alteration, Coastal and Estuarine Zone - WRPA 10

Location	Mississippi River Flow (c.f.s.)	Mississippi River Flow (m.g.d.)
Lake Pontchartrain-Lake Borgne	17,700	11,400
Breton Sound Area	1,800	1,200
Caminada-Barataria-Bastian Bay Area	14,000	9,100
Caillou-Terrebonne-Timbalier Bay Area	9,800	6,300
Total	43,300	28,000

Water Level Management

Water levels are satisfactory and will likely remain so; therefore, there are no supplemental water needs for Water Level Management in the coastal and estuarine zone.

Shoreline Erosion

Shoreline retreat is occurring throughout WRPA 10 at varying rates (figures 25 and 26). For a detailed description of shoreline erosion in WRPA 10,see the "National Shoreline Study, Inventory Report - Lower Mississippi Region, July 1971.

Areas of critical erosion are shown on figure 26 and discussed below.

Grand Isle

Prior to 1935, a recession of about 1,500 feet occurred at the western end of Grand Isle, which was equaled by the advance of approximately the same amount at the eastern end of the island. Since that time, 6,000 linear feet of shoreline at the western end of the island has advanced about 1,000 feet gulfward, while erosion varying from 100 to 300 feet near the center of the island to about 500 feet at the eastern end, occurred east of this area. The western end of Grand Isle is in a cyclic state of accretion and erosion. The construction of 1,000 feet of jetty at the eastern end of Grand Isle in 1959 and an extension of 1,700 feet in 1965 have resulted in accretion west of the jetty.

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

SHORELINE CHARACTERISTICS

WRPA 10

FIGURE 25

LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY

HISTORICAL SHORE CHANGES

WRPA 10

FIGURE 26

Fort Livingston

Located on the western end of Grand Terre Islands, Fort Livingston is being eroded by tidal currents.

Fort Pike

Located on the Rigolets, Fort Pike is being eroded by tidal currents.

Illinois Central Railroad

Traversing the St. John the Baptist shoreline of Lake Pontchartrain, the Illinois Central Railroad is being eroded by wave attack.

Fontainebleau State Park Beach

Located on the north shore of Lake Pontchartrain, Fontainebleau State Park Beach is being eroded by wave attack.

Table 15 shows the estimated needs for shoreline erosion control. Needs presented are the same for the years 1970, 1980, 2000, and 2020 under both the National Income and Regional Development objectives.

Table 15 - Estimated Shoreline Erosion Control Needs, Coastal and Estuarine Zone - WRPA 10

Area	Miles
Grand Isle	6.3
Fort Livingston	0.1
Fort Pike	0.1
Illinois Central Railroad	2.1
Fontainebleau State Park Beach	1.5
Total	10.1

METHODOLOGY

METHODOLOGY

The sediment transported by the Mississippi varies with the flow, both as to total quantity and concentration. Under existing conditions, the Mississippi River below Old River transports, in an average year, some 300,000,000 tons of sediment. This amounts to an average rate of 825,000 tons per day. The average discharge in the lower Mississippi is 450,000 cfs; hence an average of about 1.8 tons of sediment per day is carried for each unit of discharge. The estimated average weight of sediments in the Mississippi is 1.5 tons/cubic yard1/.

The effectiveness of a unit of sediment in developing new land by subdelta formation is dependent upon numerous factors, including, inter alia, water depth, flow regimen, tidal currents, and wind. A study correlating subdelta growth with sediment input has been conducted to provide a basis for estimating the likely effectiveness of controlled diversions of riverflow in creating new land by deltaic action. The study centered on the history of four major modern subdeltas: Baptiste Collette, Cubits Gap, West Bay, and Garden Island Bay. The efficiency of sediment retention ranged from about 50 percent to over 90 percent. The average rate is indicated to be 70 percent1/.

An example of riverflow required to produce dynamic equilibrium in WRPA 10 follows:

Land acretion rate = 13 square miles/year

Average depth of land acretion = 11.9 feet

Mississippi River sediment load = 1.8 tons/c.f.s./day

Efficiency = 70 percent

$$\text{Riverflow (c.f.s.)} = \frac{\text{Land acretion x weight of sediment/unit}}{\text{70 percent (efficiency)}}$$

$$= \frac{13\ \frac{\text{sq.mi.}}{\text{yr.}} \times (5280)^2\ \frac{\text{sq.ft.}}{\text{sq.mi.}} \times 11.9\ \text{ft.} \times 1.5\ \frac{\text{tons}}{\text{cu.yd.}}}{27\ \frac{\text{cu.ft.}}{\text{cu.yd.}} \times 365\frac{\text{day}}{\text{yr.}} \times 1.8\frac{\text{tons}}{\text{cfs/day}} \times 0.7} = 522{,}000\ \text{c.f.s.}$$

1/ See footnote 2 on p. 8

1/ Ibid

Water needs for salinity alteration and/or water level management were determined by the Ad Hoc Interagency Fish and Wildlife Study Group for the Louisiana Coast and the Atchafalaya Basin1/. A detailed methodology for needs determination is contained in the interagency report. A brief summary of the methodology follows:

Flow requirements to maintain critical values of salinity at key salinity stations were established through graphic and statistic analysis of salinity maps and salinity data.

Total average water yield was obtained through the use of rainfall data. Monthly values of precipitation surplus and precipitation minus potential evaporation were determined. Values of total dry land and wetland areas were obtained. These data served as the input for a computer program chain that ultimately provided the total average water yield in gallons by months.

A comparison of the total water yield with flows required to maintain critical salinities showed the existence of deficits and indicated the need for supplemental water. The analysis of a historical array of such deficits permitted estimates to be made and exceedence graphs to be plotted of the quantity and frequency of future requirements of supplemental water for salinity control and/or water level management. Both requirements were met by establishing the critical salinity as 15 p.p.t. and allowing this level of salinity to be exceeded no more than 5 percent of the time for an average 10-year record. Monthly flows from exceedence graphs were averaged for the annual flows (needs).

The determination of needs for shoreline erosion control in the coastal and estuarine zone was based on information contained in the National Shoreline Inventory2/. Briefly, the determination of erosion rates in that report was based on studies of two sets of maps of the coastal zone, prepared at an interval of approximately 30 years. The extent of erosion, in terms of numbers of miles affected, was obtained from map measurements. Of the overall shoreline affected by erosion problems, 10.1 miles of shoreline was categorized as critical because the rate of erosion, considered in conjunction with economic, industrial, recreational, agricultural, navigational, ecological, and other relevant factors, indicated that action to halt erosion may be or may become justified. This length of shoreline (10.1 miles) constitutes the net shore protection need.

1/ See footnote 2 on p. 8
2/ See footnote 5 on p. 8

WATER RESOURCES PLANNING AREAS